Notes from the

FISH / FORESTRY INTERACTION PROGRAM

Queen Charlotte Islands Workshop

October 21 - 24, 1986

Sandspit, British Columbia

Sponsored by:

B.C. Ministry of Forests and Lands
B.C. Ministry of Environment and Parks
Canada Department of Fisheries and Oceans

88-01697/

Notes from the Fish / Forestry Interaction Program Queen Charlotte Islands Workshop, October 21 - 24, Sandspit, British Columbia

Edited and Compiled by:
Vincent A. Poulin[1] and Mary Morris[2]

[1]V.A. Poulin & Associates Ltd.,
2153 West 46th Avenue,
Vancouver, B.C.
V6M 2L2

[2]P.O. Box 131
Queen Charlotte City, B.C.
V0T 1S0

May 1987

PREFACE

The Fish/Forestry Interaction Program (FFIP), a multi-disciplinary research study, was initiated in 1981 to work towards resolution of "conflicts between steep slope logging and the integrated management of fish and forest resources on the Queen Charlotte Islands" (Poulin 1984)*. The program was started following a series of major winter storms in 1978 that triggered landslides over much of the Queen Charlotte Islands forest land base. Originating on steep, logged-over slopes, many slides deposited tonnes of debris in streams and on valley flats. The events raised private and public concerns over logging practices on the islands and prompted the establishment of the 5 year program. Overall objectives of FFIP were:

- to study the extent and severity of mass wasting and to asses its impacts on fish habitat and forest sites.
- to investigate the feasibility of rehabilitating stream and forest sites damaged by landslides.
- to assess alternative silvicultural treatments for maintaining and improving slope stability.
- to investigate the feasibility and success of using alternative logging methods, including skylines, helicopters, and by logging planning, to reduce logging-related failures.

The program is jointly funded by direct appropriations from the Canada Department of Fisheries and Oceans, the B.C. Ministry of Forests and Lands, and the B.C. Ministry of Environment and Parks (Fisheries Branch). Participating agencies include the Canadian Forestry Service, Pacific Forest Centre and the Forest Engineering Institute of Canada (FERIC), Vancouver, B.C. Research undertaken by FFIP has been largely conducted through privately contracted professionals, post-graduate students, and co-ordinated by an independant program manager.

A series of technical reports has been produced from research conducted from 1981 to 1985. Many of the technical reports were presented during part of the four-day workshop held at Sandspit on October 21 to 24, 1986. Direct involvement of industry, agencies, the scientific community and public attending the workshop facilitated translation of results toward integration of resource operations. Panel discussions and intensive working group sessions focussed on FFIP results, their implementation and ramifications, and identified further research needs. Summaries of each of the working groups were presented to the workshop participants and are included in these notes.

Formal proceedings were not planned as an outcome of the workshop and hence, the meetings were not taped. The positive response generated by workshop participants, however, indicated it would be useful to compile a set of working notes to document the contributions made possible through the joint effots of the working group panels. In the absence of formal transcripts the answers to questions posed at the workshop and presented here are based on edited notes from the meetings, the report abstracts, and prepared notes from the guest speakers.

The workshop was co-ordinated by Nancy Wilkin and Mary Morris using facilities of The Sandspit Inn and Crown Forests. The notes were produced by V.A. Poulin & Associates Ltd. and made possible through a Canadian Jobs Strategy Job Development Program.

*Poulin, V.A. 1984. A research approach to solving fish-forestry interaction in relation to mass wasting on the Queen Charlotte Islands. B.C. Min. For., For. Land Manage. Rep. No.27.

CONTENTS

PREFACE

OPENING REMARKS AND PROGRAM OVERVIEW

- *John Cuthbert* 2
- *George Edgson* 3
- *Dave Narver* 5

PROGRAM OVERVIEW

- *Vince Poulin* 7

PRESENTATIONS

Frequency and Distribution of Queen Charlotte Landslides
- *Ken Rood* 10

Case Studies of Logging Related Slides
- *Ray Krag* 12

Alternative Harvesting Practices
- *Tony Sauder* 14

Silviculture Alternatives for Steep Slope Logging
- *Peter Sanders* 16

Effects of Mass Wasting on Site Productivity
- *Dick Smith* 17

Major Fluvial Disturbances
- *Mike Church on behalf of Bert Roberts* 19

Comparison of Channel Geomorphological Features in Logged and Unlogged Watersheds
- *Dan Hogan* 20

Fish Habitat Changes Attributed to Mass Wasting and Effects on Fish Populations
- *Vince Poulin on behalf of Derek Tripp* 21

Hillslope Rehabilitation Techniques
- *Bill Carr* 23

Panel Discussion 24

Summary of "Landslide Identification Handbook"
- *Steve Chatwin* 26

Stream Rehabilitation Techniques
- *Derek Tripp* 28

FIELD TRIPS 29

WORKING GROUP SUMMARIES

Group One: Administration
- *Terry Dyer* 31

Group Two: Administration
- *Alan Edie* 32

Group Three: Planning and Assessment
- *Rob Pollock* 33

Group Four: Planning and Assessment
- *Gerry Johnson* 34

Group Five: Roads
- *Erik Bentsen* 36

Group Six: Roads
- *Trevor Boniface* 38

Group Seven: Active Logging
- *Doug Mosher* 39

Group Eight: Active Logging
- *Ray Zimmerman* 40

Group Nine: Silviculture
- *John Duncan* 41

Group Ten: Sivlerculture
- *Sylvia von Schuckmann* 43

Group Eleven: Rehabilitation
- *Kerry McGourlick* 44

Group Twelve: Rehabilitation
- *Al Cowan* 45

Panel Discussion 47

WORKSHOP COMMENTARY
- *Bill Lefeaux-Valentine* 49

APPENDIX 1 51

APPENDIX 2 57

TABLES

1. Frequency and volume of mass wasting events entering streams by failure location and type, in logged areas relative to forested area in the Queen Charlotte Islands study basins ...11
2. Distributions of debris slides, flows and torrents by area and volume classes 13
3. Volume of live trees for slide, logged and old growth stands by age class 18
4. Mean pool area, maximum depth, and LOD cover (±1 SD) at LOD test sites in Southbay Dump Creek, June 1983 (one year post-placement) and July 1984 (two years post-placement) 28

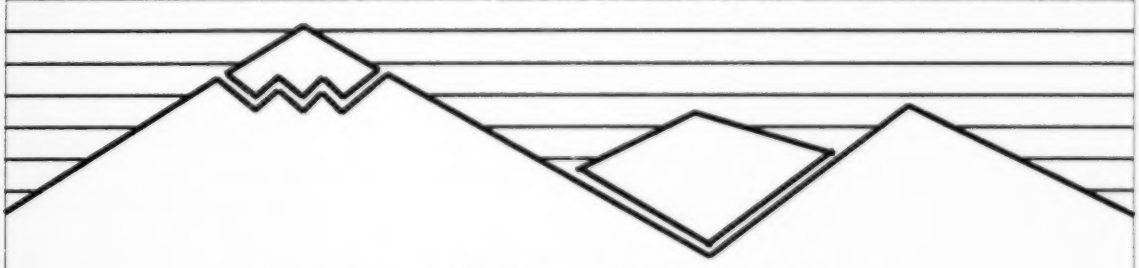
FIGURES

1. Juvenile fish habitat characteristics significantly altered by mass wasting in Queen Charlotte Islands study streams. 22
2. Integration of handbook components. 27

OPENING REMARKS & PROGRAM OVERVIEW

Day 1

Tuesday, October 21, 1986



Moderators for the day's discussions:

John Cuthbert

Chief Forester
Ministry of Forest and Lands,
1450 Government Street
Victoria, British Columbia
V8W 3E7

&

George Edgson

General Manager, Woodlands
MacMillan Bloedel Ltd.
65 Front Street
Nanaimo, British Columbia
V9R 5H9

OPENING REMARKS

John Cuthbert,
Chief Forester
Ministry of Forests and Lands

On behalf of the steering committee and my co-chairman, George Edgson of MacMillan Bloedel, welcome to the FFIP workshop. It is very gratifying to see such interest in this important area of integrated resource management. To start with, I would like to briefly outline the history of FFIP, its objectives and the specific objectives of this workshop.

How did FFIP begin? In 1978, a series of major storms triggered landslides across much of the Queen Charlotte Islands. Many resulted in damage to fish habitat and a loss of productive forest land. The landslides pinpointed forest harvesting problems specific to steep slope logging. As easily accessible land had been mainly havested, harvesting was now taking place on steeper terrain. In many cases terrian that was susceptible to slope failure which had potential for damage to downstream resources and loss of forest site. The result was public concern about logging practices and damage to fish habitat.

In 1978, the situation came to a head with a jurisdictional dispute between provincial and federal agencies. I do not intend to go over that dispute but it was an unpleasant confrontation that really did nothing to improve resource managment on the Queen Charlotte Islands.

However, one positive result was that an interagency task force was established to deal with steep slope logging problems. This task force recommended an interdisciplinary research program be undertaken which led to the organization of FFIP.

The objectives of FFIP were four fold:

1). To documnent the extent and severity of mass wasting and assess impacts on fish habitat and forest sites;

2). To investigate the feasibiltiy of rehabilitating streams and forest sites damaged by landslides;

3). To assess the use of alternative silviculture treatments for maintaining and improving slope stability; and

4). To investigate the feasibility and success of reducing logging related failures through the use of alternative logging methods.

FFIP was to be a five year program financed by the Canada Department of Fisheries and Oceans, British Columbia Ministry of Forests and Lands and B.C. Ministry of Environment and Parks. The Canadian Forest Service and FERIC have also played key roles in providing scientific expertise, manpower and logistical support.

The program was coordinated and implemented by Vince Poulin, a private sector consultant. Much of the work was done on a contract basis to ensure an "arms length relatonship" between researchers and the governmental agencies funding the work .

A steering committee of the participating agencies has provided overall executive direction. Last year was the programs fifth year and in this workshop will hear and review the results of the program.

While FERIC has been involved in FFIP from the start, the steering committee believes that there must be greater industrial involvement in the program as the program possibly enters a phase II, and we move closer to implementing the findings arising from the research.

There are several objectives to the workshop, the first is to outline the results of the research to date. Second, I hope we can identify areas where additional work may be necessary. And thirdly, most importantly, I hope our discussions can start now on how best to implement the findings of FFIP so that the optimum benefits can be obtained in better managing the fish and the forest resources of the Queen Charlotte Islands.

The program calls for comments from the steering committee. As Chairman and B. C. Forest Service representative, I will start off by saying we strongly support the process and look forward to working with the other resource agencies and industry to implement the findings in a manner that will improve overall resource management on the Queen Charlotte Islands.

Additional comments from steering committee members included: Forbes Boyd representing Department of Fisheries and Oceans; Vern Wellburn representing FERIC; Dave Winston sitting in for Ross McDonald and representing the Canadian Forest Service; Dave Narver sitting in for

Earle Anthony and respresenting the Ministry of Environment and Parks; and opening remarks from George Edgson representing the Council of Forest Industries.

George Edgson,
General Manager
MacMillan Bloedel Ltd.

This workshop which we are now beginning is another step forward in a progression of events which have occurred over the last fifteen years in the evolution of a balanced interaction between the fisheries resource and the forestry resource.

Looking back, I will highlight three events which in aggregate contain the basic ingredients that if applied diligently during this workshop will lead to a high degree of success.

First the Carnation Creek research program which has now been running continuously for almost fifteen years has probably the highest profile of the cooperative programs. Over the years a model has been evolved for the collective participation of the Canadian Forestry Service, the Department of Fisheries and Oceans, the Ministry of Environment, the Forest Service and the forest industry. While the number of industry firms involved to this point is limited, the original program is in the process of being replaced by a much broader one with forest industry representation increased through the involvement of the Council of Forest Industries.

The trials and tribulations associated with research planning, budgeting and field work, with reporting of research data and with interpretation of the research results have not always proceeded smoothly but resolution of differences have been achieved by working through perceived obstacles and actual disagreements. Over the period of this program, a level of mutual respect has been established between individuals within the organizations involved. It is critical that this momentum be used to continue to foster development of respect and credibility among an ever increasing number of individuals involved in the management of these two resources.

The second event I want to highlight had its beginning several years ago when the Council of Forest Industries and the Department of Fisheries and Oceans began discussing a program which would involve fisheries officers working for a period of time in a logging camp to develop an increased understanding of operational forestry. While the idea had difficulty getting beyond the discussion stage due in part to the impact from a sharp downturn in the economy and in a lack of commitment toward the process, the approach was revived about one year ago and an agreement was made to proceed.

A small pilot program was put together between DFO South Coast and MacMillan Bloedel on Vancouver Island. Three fisheries officers spent one week in the spring of 1986 at an MB logging diviision. Another week was planned for this fall. Following the fall project, it was obvious that both the fisheries officers and the logging division personnel benefited from the experience. An initial approach of hesitant and guarded participation has evolved into positive pro-active involvement. This is simply another example of a project which can lead to developing a greater understanding and mutual repect for our perceptions of each other.

The third event which I will highlight in the progression is the development of fisheries/forestry guidelines. This project proceeded over very rough water and rocky terrain for a number of years with very few high points and a mulititude of low points. Not surprisingly, but certainly ironic, was the fact there was general agreement in principle but very divergent views on the form and content. Working toward a common principle was severely hampered by a lack of trust and that each group developed in-house positions for which pride of authorship complicated development of mutually acceptable content.

"I fully expect that the cooperative

approach developed to this point will provide the basis for continuing an even more effective working relationship between all groups as the program continues into the future."

The establishment of a senior steering/ implementation committee provided a major breakthrough on this important step. The committee structure provided an organizational framework, a commitment to a resolution within a reasonable time frame. Equality of participation resulted in all the essential ingredients for final development of the guidelines. I feel the guideline will provide a framework of common sense which combined with site specific knowledge will result in a balanced integrated formula for better management of the fisheries and forestry resource.

These three events are what I see as a progressive evolution of fisheries/forestry interactions. They provide for us some guideposts to follow throughout this workshop.

Specifically:

1) The Carnation Creek project moved ahead with steady progress, except, when technology transfer did not consider the legitimate requirements of both resources.
2) The Fisheries officer/Forestry personel exchange established mutual interest in each other's resource and respect for each other's opinions.
3) The guidelines development process is showing that a truly joint approach by the B.C. Ministry of the Environment and Parks, B.C. Ministry of Forest and Lands, Canada Department of Fisheries and Oceans and the Council of Forest Industries can work when coupled with a good organizational structure and clear mandate despite major differences in perspective.

In summary, this workshop can be successful if all of us here respect each other's point of view, are interested in both the fisheries and forestry resource, and consider the legitimate requirements of both resources and work in a truly joint atmosphere to evolve the basis for what could be a better integrated managment of both resources.

To achieve John Cuthbert's objective's we need to set aside the tendency to:

-Use general information to fit preconceived conclusions;

-Use history to determine what can or cannot be done;

Reach conclusions by force-fitting solutions which are not practical.

Instead, we need to proceed with an open mind and objectivity to:

-Examine and interpret information and develop opportunities for improved managment of the two resources.

Our collective task is to seek ways in which to maximize benefits to society from our renewable resources on a perpetual basis. The challenge is for everyone to understand that we are here to use our collective expertise to help determine how we can effectively manage these resources.

Each of you will have a somewhat different interpretation of what I have said. All will be legitimate views, but we urge each of you to listen carefully and objectively to others - above all, with a willingness to change.

We are both, fortunate and unfortunate to be active in fields which are not exact sciences, but areas of work that are rather subject to a broad range of interpretation. Consequently, there is a substantial risk in dealing with mind sets of conventional wisdoms that can result in a narrow interpretation and a lack of willingness to listen carefully and to think through different opinions. This is exactly what needs to happen over the next four days.

The potential is within this group. Success depends on how each of you participate. Collectively, it is up to you. Thank you.

Earle Anthony and respresenting the Ministry of Environment and Parks; and opening remarks from George Edgson representing the Council of Forest Industries.

George Edgson,
General Manager
MacMillan Bloedel Ltd.

This workshop which we are now beginning is another step forward in a progression of events which have occurred over the last fifteen years in the evolution of a balanced interaction between the fisheries resource and the forestry resource.

Looking back, I will highlight three events which in aggregate contain the basic ingredients that if applied diligently during this workshop will lead to a high degree of success.

First the Carnation Creek research program which has now been running continuously for almost fifteen years has probably the highest profile of the cooperative programs. Over the years a model has been evolved for the collective participation of the Canadian Forestry Service, the Department of Fisheries and Oceans, the Ministry of Environment, the Forest Service and the forest industry. While the number of industry firms involved to this point is limited, the original program is in the process of being replaced by a much broader one with forest industry representation increased through the involvement of the Council of Forest Industries.

The trials and tribulations associated with research planning, budgeting and field work, with reporting of research data and with interpretation of the research results have not always proceeded smoothly but resolution of differences have been achieved by working through perceived obstacles and actual disagreements. Over the period of this program, a level of mutual respect has been established between individuals within the organizations involved. It is critical that this momentum be used to continue to foster development of respect and credibility among an ever increasing number of individuals involved in the management of these two resources.

The second event I want to highlight had its beginning several years ago when the Council of Forest Industries and the Department of Fisheries and Oceans began discussing a program which would involve fisheries officers working for a period of time in a logging camp to develop an increased understanding of operational forestry. While the idea had difficulty getting beyond the discussion stage due in part to the impact from a sharp downturn in the economy and in a lack of commitment toward the process, the approach was revived about one year ago and an agreement was made to proceed.

A small pilot program was put together between DFO South Coast and MacMillan Bloedel on Vancouver Island. Three fisheries officers spent one week in the spring of 1986 at an MB logging diviision. Another week was planned for this fall. Following the fall project, it was obvious that both the fisheries officers and the logging division personnel benefited from the experience. An initial approach of hesitant and guarded participation has evolved into positive pro-active involvement. This is simply another example of a project which can lead to developing a greater understanding and mutual repect for our perceptions of each other.

The third event which I will highlight in the progression is the development of fisheries/forestry guidelines. This project proceeded over very rough water and rocky terrain for a number of years with very few high points and a mulititude of low points. Not surprisingly, but certainly ironic, was the fact there was general agreement in principle but very divergent views on the form and content. Working toward a common principle was severely hampered by a lack of trust and that each group developed in-house positions for which pride of authorship complicated development of mutually acceptable content.

"I fully expect that the cooperative

approach developed to this point will provide the basis for continuing an even more effective working relationship between all groups as the program continues into the future."

The establishment of a senior steering/ implementation committee provided a major breakthrough on this important step. The committee structure provided an organizational framework, a commitment to a resolution within a reasonable time frame. Equality of participation resulted in all the essential ingredients for final development of the guidelines. I feel the guideline will provide a framework of common sense which combined with site specific knowledge will result in a balanced integrated formula for better management of the fisheries and forestry resource.

These three events are what I see as a progressive evolution of fisheries/forestry interactions. They provide for us some guideposts to follow throughout this workshop.

Specifically:

1) The Carnation Creek project moved ahead with steady progress, except, when technology transfer did not consider the legitimate requirements of both resources.
2) The Fisheries officer/Forestry personel exchange established mutual interest in each other's resource and respect for each other's opinions.
3) The guidelines development process is showing that a truly joint approach by the B.C. Ministry of the Environment and Parks, B.C. Ministry of Forest and Lands, Canada Department of Fisheries and Oceans and the Council of Forest Industries can work when coupled with a good organizational structure and clear mandate despite major differences in perspective.

In summary, this workshop can be successful if all of us here respect each other's point of view, are interested in both the fisheries and forestry resource, and consider the legitimate requirements of both resources and work in a truly joint atmosphere to evolve the basis for what could be a better integrated managment of both resources.

To achieve John Cuthbert's objective's we need to set aside the tendency to:

- Use general information to fit preconceived conclusions;
- Use history to determine what can or cannot be done;
- Reach conclusions by force-fitting solutions which are not practical.

Instead, we need to proceed with an open mind and objectivity to:

- Examine and interpret information and develop opportunities for improved managment of the two resources.

Our collective task is to seek ways in which to maximize benefits to society from our renewable resources on a perpetual basis. The challenge is for everyone to understand that we are here to use our collective expertise to help determine how we can effectively manage these resources.

Each of you will have a somewhat different interpretation of what I have said. All will be legitimate views, but we urge each of you to listen carefully and objectively to others - above all, with a willingness to change.

We are both, fortunate and unfortunate to be active in fields which are not exact sciences, but areas of work that are rather subject to a broad range of interpretation. Consequently, there is a substantial risk in dealing with mind sets of conventional wisdoms that can result in a narrow interpretation and a lack of willingness to listen carefully and to think through different opinions. This is exactly what needs to happen over the next four days.

The potential is within this group. Success depends on how each of you participate. Collectively, it is up to you. Thank you.

Dave Narver,

Director, Fisheries Branch,

Ministry of Environment and Parks

I am excited about being here today. I am stimulated with the anticipation of the productive exchange that we are all going to experience over the next few days. However, the value of this carefully planned workshop will be strongly dependent on the objectivity and the willingness of each of you to listen, digest and participate.

I am excited for several reasons:

Last week, in planning for this workshop, the steering committee and the technical advisory committee reviewed all the presentations to be given in the next two days. I was extremely impressed with the results of the past five years of field work. I think you will find that the integrated results clearly show the way to better management of forest land and the associated salmon and trout streams in the Queen Charlotte Islands. Some of the old myths will be put to bed and hopefully no new myths will be generated.

A second reason for my high adrenalin is that I have been involved in assessments and studies of coastal logging and fish since 1969. As a federal research scientist, in 1970, I was involved in the initiation of the Carnation Creek watershed study with the strong support of many individuals, agencies and companies in this room. As you know, over the past fifteen years, that study has provided a wealth of insights on how coastal watersheds produce salmon, trout and timber, how logging can influence that production and how watershed treatments can be improved. In 1970, we recognized the shortcomings of a long-term study of a single watershed. My associates and I identified the need to not only conduct an intensive, long-term watershed study, but also to conduct synoptic studies of a large number of small watersheds in various stages of forest harvesting in order to integrate the inherent variability among coastal streams. The opportunity for a full-blown synoptic approach did not appear until the start of FFIP in 1981. In the next few days you will see the value of the synoptic approach in a number of disciplines, and how this approach compliments the results from intensive, long-term watershed studies such as Carnation Creek.

A third reason that I am excited about the next several days is the broad application of the FFIP results. This study was initiated as a result of a very site-specific sore thumb in the Queen Charlotte Islands in 1978. None the less, application of the results is appropriate in numerous areas along the coast, where many of us in this room have management responsibilities and financial or recreational interests.

The point of emphasis for this workshop is that the Fish/Forestry Interaction Program is not an ivory tower exercise. Rather, it has very practical objectives focusing on how we can do a better job of managing the fish and timber resources.

I want at this time to congratulate Vince Poulin, all of the FFIP participants and the TAC for a very successful program. In 1981 when we were first held up for funding I was not very optimistic. FFIP is a great example of cooperative team research.

Let me briefly editorialize about why there is this continuing friction between forest management and fish production. The value of the coastal commercial and recreational salmonid fisheries is in excess of one-half a billion dollars. At the same time, the value of the coastal forest resources is well known. The vast majority of coastal salmon and trout are provided from natural habitats. To produce a significant portion of these fish by artifical means is just not an economic or technical option. There is no question that one of the most catastrophic events that could happen to the biology of the stream is for the vegetative cover of the watershed to be removed. Some streams are more resilient than others; the response of specific streams varies.

You might ask: will elimination of fish production in one small stream upset the western free world? Of course not. However, the strength of stocks of some species in the Queen Charlotte Islands and the central and north coast, is dependent on the aggregate production of a large number of such small streams. For this reason those small streams are important but they also are difficult to protect compared to large streams and rivers.

I do not mean to be making a special case for fish because there is an equally strong case to be made for timber removal as well.

What we must do this week is carefully consider how both these resources, so vital to the Queen Charlotte Islands, can be managed in a complimentary way. This will require objectivity and the disposal of "old tapes" outside the door.

We have some bottomline boundaries to all

this. That is, we are not going to stop logging and the loggers are not going to be permitted to wipe out the fisheries resource. So, let's go to work. Have a productive and constructive workshop.

Program Overview

Vince Poulin,
Program Manager
Fish / Forestry Interaction Program

Abstract from "The Extent and Severity of Mass Wasting on the Queen Charlotte Islands and Impact on Fish Habitat and Forest Sites" ; V. A. Poulin; October 1986; B. C. Ministry of Forests and Lands; Land Management Report, In Prep.

The logging industry on the Queen Charlotte Islands is handicapped by working in one of the most naturally unstable areas in North America. Indeed, the unique interaction of climate and topography in this area created a landscape wherein mass soil movements were endemic long before man's intrusion occurred. Inventories reveal large numbers of natural landslides throughout the forest land base. Nevertheless, studies show that steep slope logging has significantly accelerated this process.

Failure of these areas, when subjected to prevailing conditions (i.e., long periods of steady rainfall or intense seasonal storms), can trigger debris slides and debris torrents, processes which transport large volumes of material over long distances to cause major disturbance to both forest sites and streams.

"Unmaintained logging roads and clearcutting in and near gullied terrain are the principal land use practices that contribute to mass wasting events."

Once mobilized, material which enters streams from slope failures often entrains large quantities of additional material from streambeds and banks as they move downstream. As the slide slows, material in transport is deposited, leaving large accumulations of mixed gravel and debris. This process results in scouring of steeper gradient stream sections and aggradation further downstream. Surveys of channels have shown where sediment input to streams increases due to logging or debris torrenting sediment storage characteristics change. Pool area is reduced and riffles become proportionately large. Woody debris — stream features that create the hydraulic conditions necessary to develop diverse and stable fish habitats — becomes less effective. The size of material is smaller and a shift from more cross stream positions to diagonal and parallel to flow leads to an overall simplification of channel features.

In streams where slides have had a direct impact on the channel, changes in the orientation and amount of woody debris, pool depth, area of pools, amount of undercut bank and stream width reduce the quantity and quality of fish rearing habitat - - particularly overwinter habitat , a factor limiting fish production in most streams where suitable habitat is not available downstream. Sedimentation, arising from mass wasting and logging, occurs downstream of directly affected sections and achieves levels that can be detrimental to fish egg survival. In some streams, particularly torrented systems, high sediment levels can be obscured by short-term removal of fines by high rates of stream scour. In these situations, increases in fine sediments are probably less of a factor in governing egg to fry survival than the direct dislocation of eggs from the gravel by scouring.

On hillslopes, slope failures open scars that revegetate in time, but lower the productivity of forest site. Invasion by alder and continued erosion of upper slide positions result in reduced wood volume, particularly in conifers.

Results of studies show that the most damaging slope failures occur on sites with readily identifiable terrain characteristics. Given the unique natural conditions of the Queen Charlotte Islands, logging may trigger landslides regardless of the yarding system used. Nevertheless, knowledge of the types of slides attributed to logging and where slides occur provides the forest industry with opportunites to mitigate or avoid many logging-induced slope failures through logging planning and improved design, maintance and construction of logging roads. The watershed rehabilitation techniques identified during this study and discussed in Volume 2 can be effective in helping to restore post-logging stability of slide sites and in speeding the recovery of both fish habitat and fish populations.

Since the study was initiated the Queen Charlotte Islands logging industry has adopted new techniques which present less potential risk in accelerating slope failures. There has been a move from bulldozer/shovel road construction to the use of backhoes and a change in yarding systems from a dependence on highlead to a variety of systems that include the mobile yarding crane (running skyline) and tower skylines. At the same time the forest industry has demonstrated an increasing awareness of problems facing steep slope logging. Available technology and cooperative efforts by both industry and government hold promise for logging on the Charlottes.

Notes from the question and answer session:

Question: What were the problems with the gabions you mentioned?

Answer: There were changes around the gabions after storm events. We anticipated scour forming a pool at the gabion apex but instead we found lateral erosion. The V-shape caused lateral bank erosion. It was an example of a problem we don't want. That is, we don't want structures that need maintenance over the long term. We have since changed rehab emphasis to LOD where we don't have the problems found with the more mechanical structures.

Question: Are we going to examine economics of the cost of saving an area versus number of fish returning?

Answer: No. FFIP objectives were to look at impacts on fish habitat.

Question: Can these results be extrapolated to the rest of the province?

Answer: In many cases yes, debris torrents for example, will have similar affects regardless of where they occur. Many of the prescriptive studies results will have coast wide application.

Question: Are QCI debris slides/torrents similar to those in other areas?

Answer: Yes, but QCI streams may be different. Here channels are controlled predominantly by large organic debris, not bedrock.

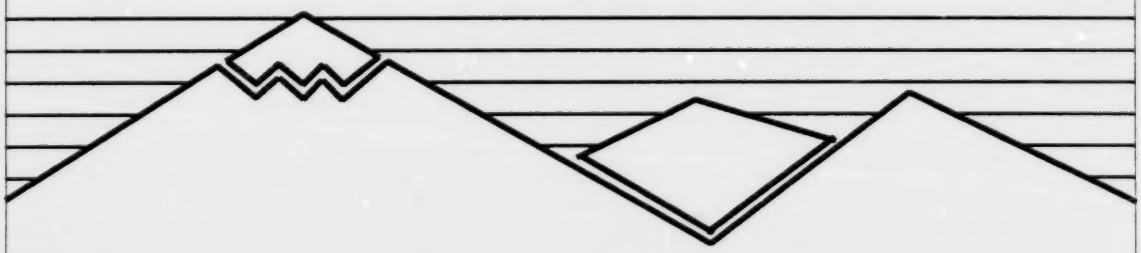
Question: Has any effort been made to correlate findings to escapement/catch for salmon here?

Answer: We enumerated juvenile overwinter survivals in several stream systems. It was not possible to follow survival through to adults within the framework of the study.

PRESENTATIONS

Day 2

Wednesday, October 22, 1986



Moderator for the day's discussions:

Mike Brownlee

Habitat Management Division
Department of Fisheries and Oceans
1090 West Pender Street
Vancouver, British Columbia
V6E 2P1

"Frequency and Distribution of Queen Charlotte Landslides"

by Ken Rood

Abstract from "An Aerial Photograph Inventory of the Frequency and Yield of Mass Wasting on the Queen Charlotte Islands, B. C. " by K.M. Rood; December 1984; B. C. Ministry of Forests; Land Management Report 34.

This study investigated timber harvesting and mass wasting on the Queen Charlotte Islands. Logging impacts on the frequency and yield of landslides from steep slopes and the volume of material entering streams were examined for a study area comprised of 27 basins covering 350 km^2 between Rennell Sound and Burnaby Island.

The influence of logging was assessed by comparing the yield and frequency of landslides calculated for clearcut and road areas to that from forested terrain. Data on the number, type, and volume of landslides were extracted from large-scale aerial photography. The yield from forested terrain was calculated from the total steepland area in the study basins, the volume associated with debris slides and debris flows, and the age range over which the landslides occurred. The typical age of the oldest landslides sampled was estimated to be 40 years. Yields from logged areas were calculated separately for roads and clearcut areas. For each basin the yield was calculated from the total volume of landsliding from roads or clearcuts, the total steepland logged area and the age of logging in that basin. The age of logging was an areally weighted average of the number of years between logging and photography. The overall yield of landslideing from clearcut and road terrain, for comparison with the overall yield from forested terrain, was calculated as an areally weighted average from the individual basins.

The yields and frequencies from forested and logged terrain were determined from 1337 landslides. In forested steepland, 4.8 landslides per square kilometer were observed for a frequency of 0.12 per square kilometer per year. In logged areas, 29.7 landslides per square kilometer were observed, increasing the frequency to 4.1 events per square kilometer per year. Within the logged area, the frequency of events ranged from 3.6 per square kilometer per year in clearcuts to 9.2 per square kilometer per year from roads.

In forested areas the yield was 1.6 m^3/ha per year. The removal of vegetation produced a yield of 50.7 m^3/ha per year, an acceleration of 31 times. Larger increases were associated with roads, where the yield of material was 144 m^3/ha per year, and the acceleration relative to forested terrain was 87 times. The yield and acceleration for debris slides in clearcut terrain on the Queen Charlotte Islands are significantly larger than those reported from similar areas in the Pacific Northwest.

"The overall effect of logging has been to accelerate the frequency of landsliding 34 times over the 7.3 year period that represents the average age of logging on steeplands in the study basins."

Approximately 39% of the total volume of mass wasting from forested terrain and 47% from logged terrain directly enter the stream system. Yields to streams were 0.6 m^3/ha per year from forested areas, 24 m^3/ha per year from clearcut areas and 75 m^3/ha per year from roads. The acceleration of yield to streams as a result of logging is slightly larger than the acceleration of the overall annual volume yield. Yields to streams are higher from road areas, but most of the total volume is from clearcuts: 78% from clearcut failures and 22% from roads. Nearly all of the yield enters the higher gradient portions of stream reaches in the upper areas of the watershed.

Notes from the question and answer session:

Question: Why is the yield from landslides higher in the QCI than in Alaska?

Answer: This study did not compare results directly to slides in Alaska, but did to those in other areas of the Pacific Northwest.

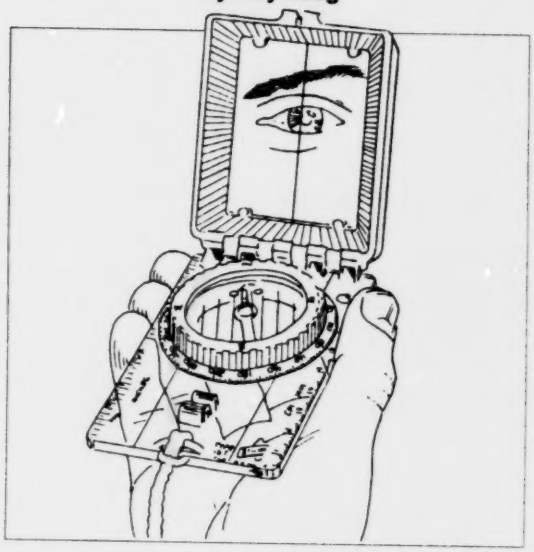
Comment *(from Doug Swanston):* QCI slides are bigger and more frequent than those in SE Alaska, probably a result of the storm patterns in SE Alaska being not as frequent. Slope gradient and soil moisture is the key factor in the frequency of QCI slides.

TABLE 1. Frequency and volume of mass wasting events entering streams by failure location and type, in logged areas relative to forested area in the Queen Charlotte Islands study basins

	Frequency			Volume		
	Logged	Clearcut	Road	Logged	Clearcut	Road
Debris slide open slope	X18	X14	X70	X9	X4	X62
Debris slide gully headwall	X31	X29	X66	X21	X16	X91
Debris slide gully sidewall	X15	X16	0	X16	X17	0
Debris slide active wall	X15	X16	0	X7	X8	0
Debris Flow	X33	X27	X70	X78	X69	X181
TOTAL	X23	X20	X55	X43	X37	X117

"Case Studies of Logging Related Slides"

by Ray Krag



Abstract from "A Forest Engineering Analysis of Landslides in Logged Areas on the Queen Charlotte Islands, British Columbia" by R. Krag, E. A. Sauder and G. V. Wellburn; August 1986; B. C. Ministry of Forests and Lands; Land Management Report 43.

FERIC conducted a synoptic survey of 102 landslides on the Queen Charlotte Islands, 97 of which originated within logged areas, to supplement the Fish/Forestry Interaction Program's air photo landslide survey and to provide forest engineering input into the interpretation of probable causes and possible preventative measures. Ninety landslides were selected from Rood's (1984) population and 12 more recent failures were added to provide information on fresh landslides. Sample landslides were not chosen randomly so statistical inferences were not made from the survey data.

Thirty-one landslides initiated from logging roads, almost all in road fill slopes. The principal factors in road-related landslides appeared to be overloading of steep slopes with till or sidecast material and inadequate control of road drainage, usually in combination. Road engineering and construction practices contributed to stability problems to some extent, but insufficient maintenance of road drainage systems, particularly on inactive logging roads, was considered to be the most significant factor in road-related failures. In the opinion of the authors, the frequency of road-related failures could be substantially reduced by improving the level of road maintenance, including putting roads to bed.

Specific causes for landslides that initiated within clearcuts but away from roads could rarely be identified. In particular, the role of yarding disturbance (gouging soils and uprooting stumps) as a failure mechanism could not be reliably distinguished from indirect logging factors (tree removal and root deterioration) or natural factors (storm and seismic activity). However, the yarding process probably accelerated landslide activity at critical points where poor deflection generated severe yarding disturbance on sensitive slopes. Reducing the frequency of this type of landslide would require maximizing available deflection through careful field layout and the use of mobile yarding systems, and minimizing the occurrance of difficult yarding situations such as that through or over major gullies.

Notes from the question and answer session:

Question: What should be done on inactive roads that are not going to be used for 10-15 years.

Answer: Roads that are not going to be used for 10-15 years require a commitment for routine maintenance if the roads are not put to bed. A road that has been put to bed does not need to be impassable to traffic, however a washed-out road is impassable.

Question: What definition of yarding disturbance did you use in your study?

Answer: Yarding disturbance was any displacement of soil, changes to soil structure or disturbed stump that was caused by yarding or yarding equipment usage. Truck roads and landings were not included as yarding disturbance, but were considered as separate factors in initiating slope failures.

Question: How does the rate of stump and log decay effect cutbank stability?

Answer: The rates of decay for stumps and logs were not studied.

Question: Were landings a significant point for failure initiation?

Answer: Landings did not appear to be a source of failure initiation for any of the landslides we examined.

Question: Did downhill yarding influence failure initiation?

Answer: Downhill yarding did not appear to influence failure initiation for any of the landslides we examined. The location of the landing site with respect to yarding was more important in influencing yarding disturbance than was the direction of yarding. Downhill yarding (on the sites we observed) did not appear to concentrate drainage.

Question: Did you examine the accumulation of debris in gullies?

Answer: The next speaker should be able to address your question.

TABLE 2. Distributions of debris slides, flows and torrents by air and volume classes

Size Class (ha)	Debris Slides No.	Debris Slides Size Ranges	Debris Torrents No.	Debris Torrents Size Ranges	Debris Flows No.	Debris Flows Size Ranges
<0 15	57	0.008-0.144 ha 7-996 m^3	6	0.018-0.129 ha. 18-2000 m^3	5	0.040-0.124 ha 314-782 m^3
0.15 0.30 ha	13	0.150-0.279 ha l37-1800 m^3	1	0.l50 ha 450 m^3	4	0.164-0.279 ha 1 066-3 075 m^3
0.30 - 0.45 ha	4	0.30l-0.423 ha 490-3 0l0 m^3	1	0.333 ha 197 m^3	2	0.406-0.430 ha 1 205-2 138 m^3
0.45 - 0.60 ha	1	0.576 ha 3060 m^3	1	0.546 ha 1 211 m^3	- -	- -
>0.60 ha	2	0.995-0.401 ha 2 806-2 986 m3	5	0.756-1.655 ha 1 168-4 658 m^3	- -	- -
Ranges	77	0.008-1.401 ha 7-3 010 m^3	14	0.018-1.655 ha 18-4 658 m^3	11	0.040-0.430 ha 314-3 075 m^3

"Alternative Harvesting Practices"

by Tony Sauder

Abstract from "Alternative Yarding Practices and Logging Planning to Reduce Mass Wasting on the Queen Charlotte Islands" by E. A. Sauder; October 1986; B. C. Minstry of Forests and Lands; Land Management Report; In Press.

The paper summarizes the FERIC yarding and planning studies. The studies were undertaken to examine the potential for reducing logging induced or associated landslides by using different cable or aerial yarding systems.

The operational performance and cost of yarding systems used to log steep and potentially unstable slopes, and the factors that limit yarding are examined. The type and amount of yarding disturbance recorded and the relationship of disturbance to yarding and the potential for disturbance to contribute to landslide initiation are discussed. The factors contributing to the logging associated landslides occurring on the study settings are presented, and a landslide frequency determined. The frequency is compared to Rood's (1984) study. Finally, conventional cable yarding (high lead, mobile yarding crane and tower skylines) systems, longline European skylines and helicopter yarding systems are examined and their yarding performance, yarding limitations and potential to reduce logging induced mass wasting is discussed.

The study is based on over 150 days of observing yarding operations over a four-year period. High lead, mobile yarding crane and tower skyline yarding systems were observed on eight settings in twelve individual case studies. Personal experiences and examination of yarding systems on other parts of the coast were used to increase the study base. All settings examined on the Queen Charlotte Islands were considered to have potential for mass wasting to occur, because of: localized slopes over 70%, the presence of gullied terrain units, and evidence of historic landslides.

The paper discusses the role logging layout and planning have in assessing and reducing the potential for logging-induced mass wasting. The current planning process and the fundamental steps of planning are reviewed, and shortcomings are discussed. Based on a detailed field examination of two study areas, the basic information requirements for effective plans are identified, and the limitations of specific yardings systems are discussed.

Notes from the question and answer session:

Question: Is the size of the opening important?

Answer: The size of the opening does not appear to be important in failure initiation, apart from increasing the potential for a landslide to occur. Windfall along cutting boundaries and landslide failures associated with timber boundaries are major problems on large areas of the Queen Charlotte Islands. For these reasons a progressive clearcut harvest pattern is used that minimizes the length of standing timber exposed along cutting boundaries and allows for recovery of windfall in the near future. Smaller clearcut units result in the same area for timber removal, greater road length to connect the small areas and a greater length of exposed timber along boundaries compared to large openings. Recovery of windfall from small openings is time consuming, expensive and ineffective as larger and larger lengths of standing timber are left exposed.

Question: What are the yarding related problems assocsiated with minimizing mid-slope roads?

Answer: Many areas on the Queen Charlotte Islands have timber from the concave slopes at the base of the hillsides to the convex slopes at the top. Reducing mid-slope roads results in:

- long downhill yarding on straight slopes that results in poor yarding and increased disturbance;
- timber left on upper convex slopes because it is too far for the yarder to reach or there is insufficient deflection; and,
- exposure of standing timber on upper convex slopes that may contribute to windfall and timber boundary landslides.

Leaving the timber on the upper slopes will increase logging in other areas or increase the cost of yarding if alternative systems that do not depend on deflection (ie helicopters) are used to recover it.

Question: What are the environmental savings associated with long-line skyline systems and helicopters?

Answer: Long-line multi-support skyline systems and helicopters have the potential to reduce the length of truck roads required on mid-slope positions because they have longer yarding distance capability and can reach over convex slopes. The environmental savings (as determined from the literature and from experience gained from this study) occur largely because of the reduction in failures associated with the reduction of mid-slope road lengths.

Question: Did you find that debris in gullies initiated any failures?

Answer: We found no evidence in our study to suggest that the yarding slash load in gullies initiated a failure. Redirected road drainage appeared to be the major initiator of the gully failures observed, however the accumulation of slash in the gully did contribute to the volume of landslide debris that was eventually deposited in the gully. The disturbance of natural large organic debris by dragging logs through the gullies may be a greater concern than the presence of increased slash. There was no attempt to limit the accumulation of slash in gullies during our studies and in some instances the slash accumulation appeared to be high. These accumulations appeared to consolidate over time as branches and small woody pieces broke-off.

Question: How can large logs be yarded?

Answer: Large logs can be yarded by reducing their yarding distance and avoid having them yarded across gullies. The most effecstive yarding occurs when they are yarded perpendicular to the contours and preferably uphill with their log fronts just clearing the ground (or stumps). Avoid having large logs dragged parallel to, or diagonal along steep slopes. The location of oversized logs should be planned for when preparing the yarding layout and should consider the landing location, yarding system, topographic features and the yarder. Remember, one oversized log can completely obliterate the successful yarding of many smaller average logs across sensitive terrain.

Question: What is the best scale for topographic mapping?

Answer: For our planning study we used 1:2500 and found it had the detail necessary (both topographic and terrain) to allow us to intensely plan logging layout with a minimum of field checking. These maps were ground surveyed and very costly in terms of field time and expense to prepare. Good 1:5000 topographic mapping should be adequate when combined with terrain mapping and detailed field verification. If good mapping is not available, and the terrain poses difficulty in yarding pattern design, then field mapping small areas at 1:2500 may be worthwhile.

"Silvicultural Alternatives for Steep Slope Logging"

by Peter Sanders.

Abstract from "Silvicultural Alternatives for the Management of Unstable Sites in the Queen Charlotte Islands: A Literature Review and Recommendations" by P. R. W. Sanders and D. J. Wilford; August 1986; B.C. Minstry of Forests and Lands; Land Management Report 42.

Forest cover plays an important role in modifying the severity and frequency of natural soil mass wasting. Removal of the forest cover through forest harvesting and the associated engineering operations can alter natural processes and aggravate inherent instability. In the Queen Charlotte Islands, steep slopes, finely textured soils, frequent seismic activity, heavy precipitation, shallow-rooting tree species and high winds predispose the area to a high natural level of mass wasting.

This preliminary appraisal reviews current silvicultural operations in the Islands and proposes alternatives. Traditional silvicultural systems are described and constraints imposed by the local conditions identified. Naturally occurring forests on the Queen Charlotte Islands are compared to projected managed forest that will replace them, and successional processes and their influence on mass wasting events are discussed. The report concludes by noting several research opportunities in the study of silviculture and mass wasting.

Notes from the question and answer session:

Question: What are the definitions of a seed tree selection system, and a group selection system?

Answer: Single tree selection means to take single trees of certain diameters, which usually results in damage to the residual stand. In group selection, the openings left between trees equal the height of the trees. On the QCI these systems are not usually appropriate because blowdown is such a big problem.

Question: What about the safety problems associated with the pre-commercial falling of waste material in overmature stands?

Answer: A pre-commercial cutting is totally unsuitable to old growth stands. The younger the stand, the more options we have for management.

Question: What are the inherent problems in second growth stands?

Answer: The natural regeneration in-growth and very high density leads to snow press and reduced crown, reduced volume and stagnation. As the canopy breaks up, trees clump, leading to reduced use of the site and lower site occupancy.

Question: Does stagnation adversely affect slope stability?

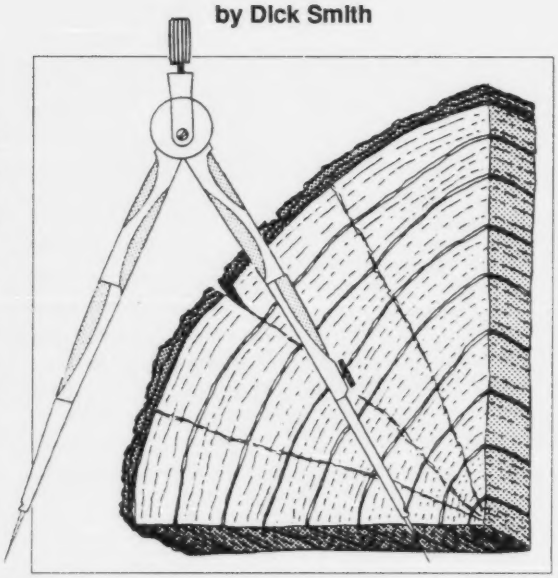
Answer: I haven't found any examples of that.

Question: What's the seasonal timing of cambrium slip (bark slip on roots)?

Answer: The results are based merely on observations: from February to the end of April. If the felling takes place at the period of root slip there is a more rapid decay of roots.

"Effects of Mass Wasting on Site Productivity"

by Dick Smith



Abstract from "Soils, Vegetation and Forest Growth on Landslides and Surrounding Logged and Old-growth Areas on the Queen Charlotte Islands" by R. B. Smith, P. R. Commandeur, and M. W. Ryan; July 1986; B. C. Ministry of Forests and Lands; Land Management Report 41.

A synoptic survey of 49 landslides ranging in age from 1 to 155 years was conducted to compare revegetation patterns and forest productivity with surrounding logged and old-growth stands. The landslides left a chaotic mixture of logs, rocks, and soils of varied proportions, further complicated by additional materials eroded from the slide edges following initial failure. The upper portion of slides was partially scoured to bedrock or more rarely to a compact glacial till, whereas the lower portion mainly consisted of slide material deposited on or mixed with original soil. Effective soil depth on the upper two-thirds of the slides was significantly less than in the lower third or in the adjacent, non-slide surround. Bedrock exposure on slides amounted to 8, 10, and 2% for upper, middle, and lower slope positions, respectively, as compared with 1,1, and 0% for non-slide terrain. For all slides and slope positions combined, exposed mineral soil and bare bedrock averaged 88% at 4 years after failure and 14% at 90 years. The reduction in bare bedrock and mineral soil exposure occurred more rapidly on lower than middle or upper slopes.

Soils on non-slide areas were chiefly Orthic or Gleyed Ferro-Humic Podzols. Soils on slides were severely perturbated but, in addition to the Orthic Regosols, many were recognized as Dystric Brunisols and Gleyed and Orthic Ferro-Humic Podzols. Organic carbon contents in mid-slide soils were high (averaging 4 to 8%). Vegetation development on these soils should be considered as secondary rather than primary in nature.

Two major trends in vegetative development on slide surfaces were observed, one dominated by red alder *(Alnus rubra)* and one dominated by conifers. The former was most common on the lower portion of slides, particularly those occurring in low elevations on material derived from fine-textured bedrock or those with a relatively high calcium content. Conifers tended to dominate on the middle and upper portions of slides, especially in high elevations on relatively coarse and acid soil material. Initial revegetation was dependent upon the availability of stable mineral soil microsites and islands of debris and other remnant organic material. Vegetation on slides was classified into eight groups and on logged areas into three groups based on dominant plants. The groups particularly reflected stages of development, degree of red alder invasion, and type and stability of substrate.

Revegetation in logged areas differed from the adjacent slides largely as a result of a higher component of western hemock *(Tsuga heterophylla)* lower stocking of red alder, and a greater proportion of stable microsites. Logged areas produce about three times the volume of wood than slides in the same (30 to 59-year) age class. A lack of older logged stands in the study precluded direct comparisons at later stages. However, based on appropriate yield tables it was estimated that the oldest group of slides, averaging 85 years of age, had produced about one-half the wood volume (conifer and red alder) of normal second-growth stands of the same age.

Notes from the question and answer session:

Question: How was soil depth measured?

Answer: Soil depth was measured using a probe up to one meter deep, anything deeper was simply categorized as greater than a meter.

Question: Was compaction of the soil restricting roots?

Answer: Compaction was not measured but I don't think that it's a problem.

Question: Is there a difference between conifer and alder in stabilizing slide sites?

Answer: The rate of root growth in alder is probably better than in conifers.

Question: What proportion of land area is in 'severe production loss' classification?

Answer: I didn't calculate the total area, but it could be 1 - 2%. It is likely a low figure, certainly not a drastic percentage of the area. If up to 5 - 10% of the area was affected it would be a concern.

Comment *(from Jim Schwab):* "In the Rennell Sound area 6.5% of the total clearcut area was affected by slides. **Q:** What is the dollar value of what's lost? **A:** If a slide affects 1 hectare of good growing site, based on my rough calculations, the site would lose about 800 m^3 per hectare. 1 m^3 of wood is worth about $200 to the provincial economy, so you can see a "considerable dollar value" is involved.

Question: Are slides one time events?

Answer: No. We often found that several slides had occurred on one site.

TABLE 3. Volumes of live trees for slide, logged and old growth stands by age class

AgeClass	State	Volume (m^3/ha) Conifer	Deciduous	Total
1 - 14	Slide	0.1	4.2	4.3
	Logged	1.4	8.8	10.2
15-29	Slide	0.5	41.7	42.2
	Logged	43.0	11.0	54.0
30-59	Slide	100.0	43.1	143.1
	Logged	353.5	123.7	477.2
60+	Slide	325.2	173.2	498.4
150+	Old Growth	669.8	4.6	674.4

"Major Fluvial Disturbances"

presented by Mike Church
on behalf of Bert Roberts.

Abstract from "Stream Channel Morphology: Major Fluvial Disturbances in Logged Watersheds on the Queen Charlotte Islands" by R. G. Roberts; 1986; B. C. Ministry of Forests and Lands; Land Management Report; In Press.

Reconnaissance investigations of disturbed stream habitats early in the Fish/Forestry Interaction Program studies identified extensive, recently accumulated sediments in mid-reaches of some streams. Channel width has increased by up to 10 times, and the depositional zone is in the order of 1 km in length. From historical air photo and land use studies it was determined that the sediment wedges were initiated by streamside and in-stream logging practices before 1970.

A decade-long sediment budget was estimated for each basin to determine the relative importance of adjacent stream bank erosion (on-site land use effect) and other sediment sources -- including off-site land use effects -- in contributing to the sediment wedges. The most significant sediment sources in each basin were assessed in the field: minor sources were compare with regional results. Stream banks and landslides were estimated to contribute two-thirds to three-quarters of all sediment delivered to the streams, with stream banks accounting for half or more of the sediment in three of four cases. Sediment comparisons between stream bank and bed sediments confirm the local provenance of the material.

Sediment stored in the wedges varies from all of the +1mm input since disturbance, to possibly as little as one-quarter of the material. Long-term sediment outputs as bed load transport vary from 0 to about $10^3 m^3$ per year. Because far more sediment is stored in the channels than is annually transported out, the wedges will persist for a long time.

Notes from question and answers session:

Question: Regarding erosion from streambanks, is it influenced by upslope material entering the stream?

Answer: Yes, considerably. Bank instability literally propogates itself.

Question: When would this technique be available for field use?

Answer: It needs refinement but field staff could do this now. It's just a matter of training them.

Question: Do you have a quantitative handle on disturbance?

Answer: We need to test it for smaller disturbances. We also hope to refine assessment of the 'regional rate' from sediment sources.

Question: The drainages studied are small. How does this apply to larger drainages?

Answer: Larger drainages can handle changes in sediment input better. In larger streams sediment "feeds through in a more orderly fashion".

Question: Stream gravel accumulations in midslope reaches affect fish habitat and migration. Is it feasible to remove gravel? and use it on roads?

Answer: In some cases you could borrow material from aggraded sections but considerable judgement is needed on where and when. Don't forget the hydraulics of debris that produce fish habitat. **Q:** But don't we need to maintain water in dry season? **A:** Winter habitat is the bottleneck. We need debris to create habitat diversity for overwinter survival.

"Comparison of Channel Geomorphological Features in Logged and Unlogged Watersheds"

by Dan Hogan

Abstract from "Channel Morphology of Unlogged, Logged and Debris Torrented Streams in the Queen Charlotte Islands" by Daniel L. Hogan; June 1986; B. C. Ministry of Forests and Lands; Land Management Report 49.

This study compares the morphology of coastal, gravel-bed streams in two logged, one logged and debris torrented, and two unlogged watersheds in the Queen Charlotte Islands. The influence of both logging and direct mass wasting events on channel morphology and, consequently, on the in-stream physical habitat of salmonids is quantified. The comparison also provides a basis for determining habitat rehabilitation criteria for damaged channels. Pools and riffles are discussed in detail.

Longitudinal profiles of long channel segments indicated that channels in watersheds either logged to the channel banks by old techniques (but not torrented), or logged by more recent methods (but which have experienced direct mass wastage events) result in reduced pool-to-pool spacings, increased riffle heights, and altered pool depths. Increases in stored sediment volumes produce proportionally larger riffles and smaller pools, thus reducing available rearing habitat. No significant differences in pool and riffle characteristics were found between unlogged watersheds and those logged by contemporary techniques and not torrented.

Large organic debris (LOD) appeared to be a major influence on stream morphology. A comparison of reaches indicated that LOD characteristics were altered in older logged and torrented channels, including a shift in the LOD size distribution, with smaller in-channel material being more prevalent. Orientation of material was also altered: more LOD lay parallel to the flow direction, as opposed to the more common diagonal orientation found in unlogged and non-torrented channels. This shift in orientation was responsible for a reduction in channel width and depth variability, reduced sediment texture variability, fewer cut banks, smaller pool areas, and decreased channel stability. These changes resulted in reduced habitat diversity and quality. No morphological differences were detected between unlogged and recently logged (non-mass wasted) reaches.

Results of this study suggest the architecture of unlogged channels can be duplicated to help rehabilitate streams damaged by mass wasting. LOD should play a major role in rehabilitation, and several recommendations for channel restoration are made.

Notes from the question and answer session:

Question: What are the effects of a large dam of debris and material in a torrented stream?

Answer: Debris jams produce both upstream and downstream effects. Upstream of the jam a sediment wedge develops for a length determined by the height of the jam and the slope of the channel. The sediment wedge produced is relatively flat on the surface and stores gravel. Downstream, a jam causes gravel deprivation, resulting in downcutting and streambed armouring. Over the long term, jams ultimately fail and release fine sediments into a stream which are subsequently transported to downstream areas.

Question: Regarding debris anchoring, how are LOD attached?

Answer: LOD is anchored in four ways. 1) LOD may be incorporated in the bank and anchored by the riparian vegetation root web; 2) if the root wad is attached to the LOD, it may anchor in overbank areas; 3) the LOD may span the stream and be anchored on both ends; and 4) LOD may anchor in the stream bed, with debris partially burying it and holding it in place.

Question: What is the importance of LOD in very large streams?

Answer: All of out work has been done in streams up to the size of Bonanza and Hangover Creeks (70 sq km^2 maximum); the results cannot be applied to larger streams such as the Yakoun without caution.

Question: How far downstream does torrenting and harvesting effect channel morphology?

Answer: The affects are going to influence the entire channel length, in time.

"Fish Habitat Changes Attributed to Mass Wasting and Effects on Fish Populations"

presented by Vince Poulin
on behalf of Derek Tripp

Abstract from: "The Effects of Mass Wasting on Juvenile Fish Habitats in Queen Charlotte Islands Streams" by D. B. Tripp and V.A.Poulin; 1986; B. C. Ministry of Forests and Lands; Land Management Report 45.

The effects of mass wasting, primarily debris torrents, on salmonid juvenile rearing habitat in streams on the Queen Charlotte Islands were assessed in 1981-1982 with a synoptic survey of 44 streams, followed later by a more detailed survey of seven streams in 1983-1984. Streams in the synoptic survey included both logged and unlogged streams, whereas only logged streams were included in the detailed survey. While it was not the intent of the study to assess the effects of logging *per se* on stream habitats, where appropriate, changes attributed to logging alone are also described.

Substantial reductions in both the quantity and quality of fish rearing habitat were found in first and second order perennial streams affected by debris torrents. The greatest impacts occurred in streams below 7% gradient, the general upper limit of habitat utilized by species such as coho salmon. In these zones, debris torrents reduced average net pool depth by an estimated 20-40%, pool area by 38-45%, and undercut bank cover by 76%. Large organic debris (LOD) cover was also reduced by 57%, primarily because of a reduction in the number of LOD pieces present, and shifts in the orientation and position of LOD relative to stream flows. Other major changes included a significant increase in rooted stream width due to excessive scouring in sediment transport zones, and infilling and lateral channel movements in deposition zones. Dewatering reduced wetted stream width.

A comparison of winter and summer cover characteristics of torrented and non-torrented streams revealed that while summer cover properties changed as a function of torrenting there was no difference in total summer cover area between stream types. This was attributed to a shift from the rootwads, coarse woody debris, undercut banks and deep water cover types found in non-torrented streams to rock and boulder cover associated with surface turbulence in torrented streams. Winter cover characteristics included pools with woody debris, undercut banks and deep-water where fish could seek refuge from high velocity stormflows. These features were reduced in torrented streams by 79%, and by 50% in intermediate streams (flood damaged and partially rehabilitated torrented streams). In the most severly affected stream studied the total amount of suitable overwinter habitat in the entire accessible portion of stream averaged 0.4% of the stream area, compared to 17.8% in non-torrented streams — a decline of 98%.

Torrented streams had not only less cover overall than non-torrented streams, they also exhibited a more restricted range of habitats. There were no undercut banks associated with pools controlled by woody debris in any of the torrented reaches examined, and only rarely were rootwads present. In addition, woody debris cover located in pools of non-torrented streams was almost always associated with abundantdeep-water cover. In contrast, pools associated with woody debris in torrented streams were comparitively small and shallow in relation to the amount of debris present.

Seventy-three percent of pools in non-torrented reaches were formed by scouring around LOD, compared to only 40% of pools in torrented reaches. Boulders, in contrast, accounted for 46% of the pools scoured out in torrented reaches, but only 13% on non-torrented reaches. Where non-torrented streams usually had a complex assemblage of LOD controlled lateral scour, plunge, backwater, and dammed pools, torrented streams typically had only simple lateral scour and cascading 'pocket-type' pools.

When they first occur, debris torrents affect, on average, the upper two-thirds of the habitat available to anadromous fish in first- and second-order logged streams. Significantly less habitat is affected in unlogged streams. Downstream of directly affected stream reaches, there were no obvious changes to fish rearing habitat, apart from those caused by logging. From the synoptic survey data, effects attributed strictly to logging included a 27% reduction in woody debris cover or about half the amount removed by mass wasting, and a 74% reduction in undercut bank area, about the same removed by mass wasting.

Abstract from "The Effects of Logging and Mass Wasting on Salmonid Spawning Habitat in Streams on the Queen Charlotte Islands" by D.B. Tripp and V.A. Poulin; 1986; B. C. Ministry of Forests and Lands; Land Management Report 50.

A combination of synoptic surveys and detailed studies was used to assess the effects of logging and mass wasting on salmonid spawning habitats in steepland streams on the Queen Charlotte Islands. Gravel composition was determined at 69 sites in 22 streams using a McNeil gravel sampler to collect 40 Kg samples of gravel at each site for sieve analysis, while gravel stability was measured at 96 sites in 12 streams using vertical erosion monitors. To estimate potential egg losses due to scouring, gravel scour depths were further compared to the vertical distribution of chum and coho salmon eggs in recently completed redds.

Declines in coho egg-to-fry survival due to logging and/or mass wasting related increases in fine sediment levels are estimated at 15 to 20%. Logging alone accounted for as much of the decline in gravel quality as mass wasting upstream. This indicates that the cumulative impacts of other sediment sources associated with timber harvesting may be at least as great as those caused by a single conspicuous event like a debris torrent upstream. Where logging and mass wasting upstream occurred together there were only slight additional increases in the amount of fine sediments present in spawning gravels. Further increases tended to be obscured by increased gravel scour resulting from large-scale changes in channel morphology. In logged stream reaches directly affected by mass wasting, or in streams where bedloads appeared to be excessive because of mass wasting events upstream, estimated egg losses due to scouring ranged from 66-86% for chum salmon and 45-70% for coho salmon. In other logged but otherwise stable stream reaches with no recent mass wasting, scour related egg losses ranged from 2-14% for chum salmon and 0-4% for coho salmon.

No questions were noted.

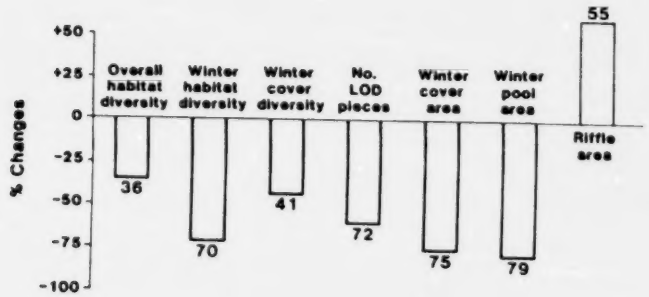


FIGURE 1. Juvenile fish habitat characteristics significantly altered by mass wasting in Queen Charlotte Islands study streams.

"Hillslope Rehabilitation Techniques"

by Bill Carr

Abstract from "Watershed Rehabilitiation Options for Disturbed Slopes on the Queen Charlotte Islands" by William W. Carr; December 1985; B. C. Ministry of Forests and Lands; Land Management Report 36.

Surface erosion and mass wasting in forested watersheds can increase significantly following road development and logging. This is particularly true on steep forested slopes that receive a great deal of precipitation, such as those on the Queen Charlotte Islands. Through proper planning and the use of high construction standards, many of these problems can be alleviated, but not completely controlled. In addition, unforseen problems that result in accellerated surface erosion and mass wasting may arise. For these reasons, the forest manager must have a variety of measures to either control erosion or lessen its impacts.

This report reviews both prevention and rehabilitation techniques that may be of use in controlling erosion and/or alleviating further erosion damage on the Queen Charlotte Islands. To date, little erosion control or land rehabilitation work has been carried out on forested land on the Charlottes, and it is hoped that this report may provide the basis for future activities in this field.

Notes from question and answer session:

Question: Are the shrubs that were planted self-sustaining?

Answer: So far, yes, and I can add the technique has done well in other areas.

PANEL DISCUSSION

Moderator: Mike Brownlee

Panel members: Peter Sanders, Bill Carr, Mike Church, Ray Krag, Dan Hogan, Ken Rood, Herb Klassen, Vince Poulin, Tony Sauder, Dick Smith.

Question *(to Poulin):* Riley Creek started the FFIP idea. How is it now years after the events?

Answer: One could say alive and well because there are still fish there, but creeks in the area are still having problems. Gravel measured below the bridge was clean, owing to increased gravel scour. Downstream gravel collection indicated Riley Creek was as "dirty" as any other logged stream. Based on that we would expect lower egg survivals.

Question *(to Poulin):* Was there any effort to separate the effects (on fish) on streams of different gradients?

Answer: In torrented streams, effects to rearing habitat largely occured between 7 and 3% to 3.5% gradient which represented the scour zone of a slide. In lower gradient stream sections few changes occured in rearing habitat but increased sedimentation was documented in logged and mass wasted reaches.

Comment: This needs clarification with definition of gradient of stream used for overwintering. We also need a perspective on the number of fish produced from such streams.

Question *(to Poulin):* You said there are 200 QCI fish bearing streams. What is the area of stream habitat directly affected by landslides?

Answer: We haven't quantified total area affected.

Question *(to Poulin):* What are the effects of mass wasting on adult returning stock?

Answer: We don't known what happens to fish after they leave the stream. FFIP focused on effects the of landslides on fish habitat, not stock production. FFIP did examine fish populations from the standpoint of juvenile summer densities and overwinter survival, but our studies were not designed as long-term investigations that could produce that kind of information.

Question *(to Poulin):* Isn't it true that our streams' (habitat) are underutilized?

Answer: Each stream has to be evaluated individually, but certainly the affected ones are.

Question *(to Sanders):* Regarding extremely thick regen, what about root grafting?

Answer: There is evidence of root grafting by age 9 in stands of 10 000 stems per hectare, but we could not quantify the exact time of root web establishment. Nor are we certain whether felling at a certain time of year affects the rate of root web establishment. **Q:** What was the height of that stand? **A:** Three to four meters, with 30-40% crown closure.

Question *(to Sanders):* How were the plots lifted for root egress measurement?

Answer: Explosives were used to loosen the trees out of the ground. Other methods such as hydraulic removal destroys the roots and you can't dig up the trees. An objective of future studies is to establish when the grafting happens and at what age. It is also possible that a root stimulant may hasten root graft and root web formation.

Question *(to Church):* What kind of descriptive measurement should be taken to establish stream sediment budgets?

Answer: Take photos of the channel, from year to year and note changes in stream the width over time. If changes such as braiding and bank erosion occur this will indicate a loading of sediment to the system. **Q:** What about point sample system? **A:** I don't want to say, you really need the longitudinal information and stream history. It would be great to have a historical air photo collection.

Question *(to Hogan):* How clean should channels be? What size of material can be left? Should streams be hand cleaned? What about leaving large stable debris by large streams?

Answer: In a large stream LOD must be anchored, and of course LOD in small channels is important. **Q:** Then why leave a strip of LOD on large size stream? **Comment:** Sometimes large trees are left not just for LOD but for bank stability. For example on the Artledge River, trees were left to protect side channels. **Q:** So is LOD in large streams effective or not? **A:** Yes, particularly in backchannels. In large rivers, the main channel is not used extensively by juvenile fish but side channels are. In the Morice River, debris created sidechannels, are used for spawning and rearing. Trees on banks provide bank stability.

Question *(to Chris Dragseth):* Has there been a comparison of fish returns before and after

logging, specifically on Riley, Gregory and Bonanza Creeks?

Answer: Those streams saw the best escapement in ten years for pinks but have had no fishery there since the 1970s. There was no count for cohos.

Question *(to Sanders):* Is there a difference in regen on south Moresby Island compared to the northern Charlottes?

Answer: Hemlock tends to suppress its own growth in extremely dense stands, perhaps due to the different bedrock. The slides on Burnaby Island show much slower rates of recovery than other slides. Forest site index differences correlate with the differences in bedrock on geologic mapping.

Question *(from Jim Henry):* What is the length of time that a stream is affected by slides? That is, what is the term of the risk of damage to streams from slides?

Answer: It can be for a considerable time, streams torrented in 1978 have still exhibited significant habitat impairment.

Question *(to Poulin):* What was the definition of 'logged stream' in the fisheries study?

Answer: Logging was defined as a clearcut adjacent to the stream or reach, on one or both sides. Streams referred to as "old logged streams" were streams logged over 15 years ago. Streams classified as new or recent were logged an average of 7 or 8 years ago.

Comment: on term of risk (Question above): Major channel changes are here for a while once torrenting of the stream has occurred. Habitat will not be restored until such time as debris fall into the stream can allow a stream to reestablish a stable network of pools and riffles.

Question *(to Smith):* What was the soil pH over time?

Answer: A pH of about 3.0 was as low as it will get on slides. That affects the metals in the soil in the same ways as in other podzols.

Question *(to Hogan):* Is the orientation of LOD in logged versus unlogged stream is different? And why?

Answer: Yes, because there is more shifting of material in logged streams.

Question *(to Krag):* You indicated there has been a reduction in the frequency of slides in logged areas. Can you predict how much this could continue to be reduced with improvements inroad construction techniques?

Answer: Quite a bit. It's already better with the advent of road rehabilitation, the putting of roads to bed, better construction, improved location, and earlier recognition of sensitive sites by terrain mapping. In terms of silvics, it's hard to recommend techniques within economic bounds. There are slope rehab things we can do.

Question *(to Church):* What about watershed management?

Answer: We should learn to manage watershed systems, not individual slides. The trick is to not disturb the systems too much.

Summary of "Landslide Identification Handbook"

by Steve Chatwin

Reference: "Landslide Identification Handbook" by Don Howes, the Ministry fo Environment and Parks; Steve Chatwin ad Terry Rollerson, MacMillan Bloedel; and Jim Schwab, the Ministry of Forests and Lands.

A field guide is being prepared to assist forest field engineers in the assessment and management of terrain that may be susceptible to landslides. The guide is in the initial writing stages and a first draft is expected by May 1987.

The guide will be divided into four sections:

1. A review of slope processes and impacts
2. Procedures used to identify unstable terrain
3. Field measures for the control of unstable conditions
4. Site rehabilitation

Figure 2. illustrates how these components are integrated.

Chapter 1: "A review of slope processes", will outline the physical setting of the coast, describing those aspects of the geology, glacial history, tectonics, climate and topography that contribute to making the coast one of the most landslide prone in the world. The types of landslides will be reviewed and a classification system will be established.

Chapter 2: "Procedures for identification of unstable terrain", will use a flow chart to guide the user through the various office and field sources of information. Office sources include air photo analysis; topographic, terrain, and interpretive maps; remote sensing; and research results. Field indicators of instability include:

a. terrain features -slope angle, material type, bedrock geometry and evidence of old slides.
b. hydrologic indicators -surface and subsurface
c. vegetative indicators -hydrophytes, deformities

The section will include a field check list.

Chapter 3:"Field measures for the control and management of unstable conditions", is divided into four sections.

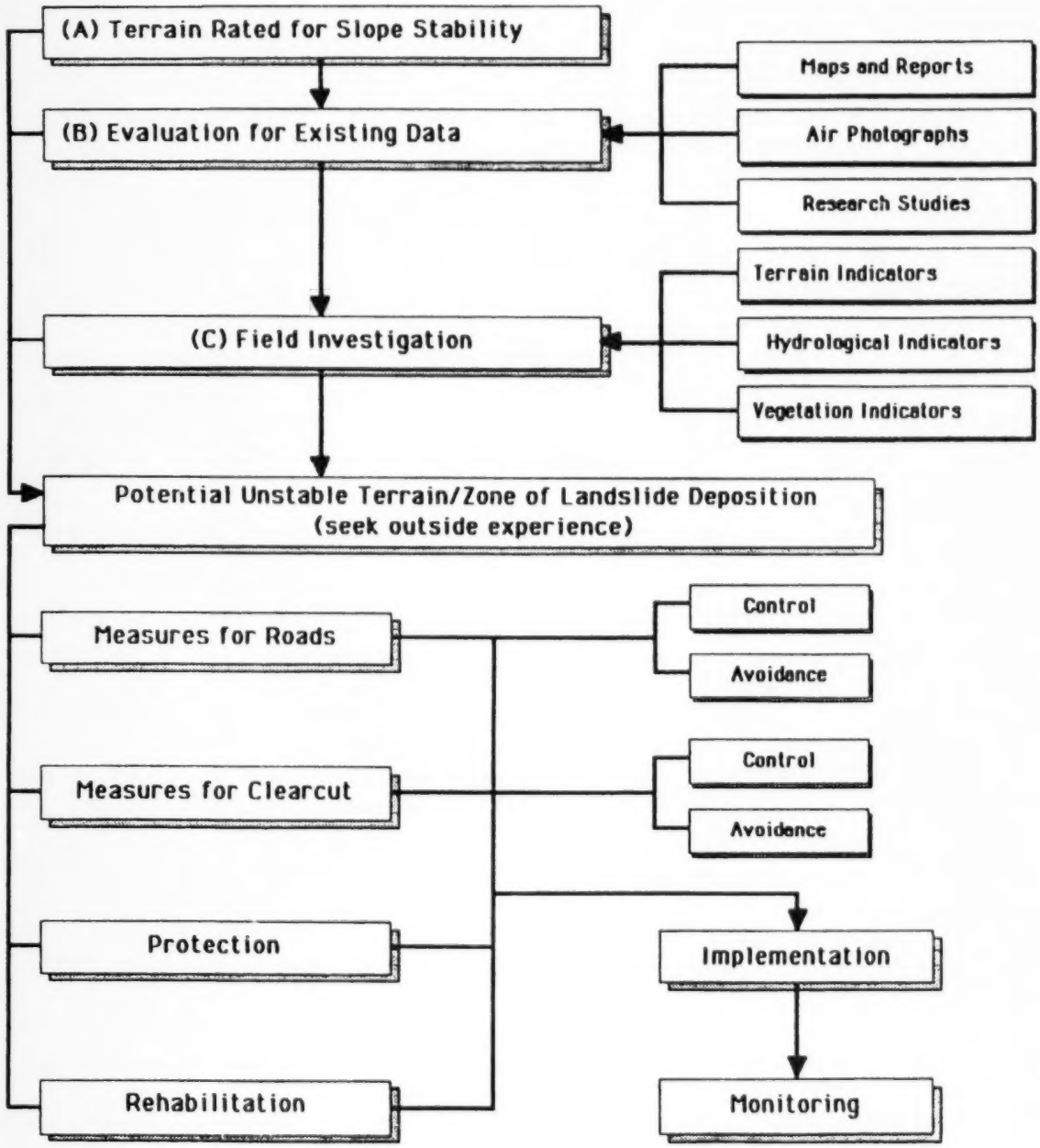
a. **Avoidance** measures include relocation of roads to stable slopes, delineating windthrow triggered slide areas, bridging of unstable areas, and camp locations.

b. **Stabilization** techniques can be divided into excavation, drainage, buttresses and retaining structures, each with a number of applicable methods.

c. **Prevention** measures involve site-specific road and cutblock design so that instability problems are not created. Topics involve cutblock design, operating in gullied terrain, road construction, and culvert management.

d. **Protection** measures are applied after stabilization methods have failed to stabilize a slope, and there is something of value downslope. Methods of dealing with inevitable debris torrents, rockfall and landslides are dicussed.

Chapter 4,"Site Rehabilitation", will cover current methods being used to arrest on-going mass wasting and surface erosion. Techniques in bio-engineering and hydroseeding will be discussed including fertilizers, mulches, soil stabilizers and seed mixes. Methods of site preparation and seed application equipment and techniques will be included. Propogation and planting measures for woody species will also be discussed.


(A) Terrain Rated for Slope Stability
(B) Evaluation for Existing Data
Maps and Reports
Air Photographs
Research Studies
(C) Field Investigation
Terrain Indicators
Hydrological Indicators
Vegetation Indicators
Potential Unstable Terrain/Zone of Landslide Deposition
(seek outside experience)
Measures for Roads
Control
Avoidance
Measures for Clearcut
Control
Avoidance
Protection
Implementation
Rehabilitation
Monitoring

"Stream Rehabilitation Techniques"

by Derek Tripp - evening presentation.

Abstract from : "Using Large Organic Debris to Restore Fish Habitat in Debris-Torrented Streams" by D. Tripp; 1986; B. C. Ministry of Forests and Lands; Land Management Report 47.

Large organic debris (LOD) was introduced into a small debris-torrented stream in 1982 in an attempt to increase the amount of pool habitat available for overwintering coho. After one winter, the number of pools present in an experimental section of the stream increased from four to fourteen, the number of pool types increased from three to six, pool area increased from 2.5 to 18.4%, and LOD cover increased from 2.2% of the wetted stream area to 11.2%. After a torrent-like summer flood and a second winter, the number of pools present had increased again to 21, while the amount of LOD cover and pool area was 17.7 and 15.4% of the total stream area available, respectively. By comparison, pool number, pool diversity, pool area, and LOD cover all remained relatively constant in a control section over the same time period. The stream was torrented again in spring 1985, at which time the only structures still in place and functioning, were those that had been cabled to trees and stumps alongside the stream.

Compared to a control section, coho overwinter survival in the experimental section increased from 13 to 52% in the 1st year, while smolt production increased from 290 fish per kilometre of stream to 1050 fish per kilometre. The second year, coho survival declined to 10% and smolt production to 140 fish per kilometre of stream, but both were still considerably higher than those in nearby torrented streams without new LOD. Benefit/cost analysis based on the first year's results indicated that the benefits derived from increases in coho production could pay for the cost of new LOD emplacements after five or six years, as long as there is no more mass wasting. Because three LOD emplacements were still creating new rearing habitat after a debris torrent, restoring LOD in streams is considered to be a realistic and feasible way of offsetting some of the impacts of mass wasting in productive fish habitats. Further studies are now needed to determine what LOD configurations can be used to manipulate stream flows more precisely and improve fish spawning and rearing habitats. Such structures must be able to accommodate recurrent large scale sediment movements without blocking the stream and without being destroyed.

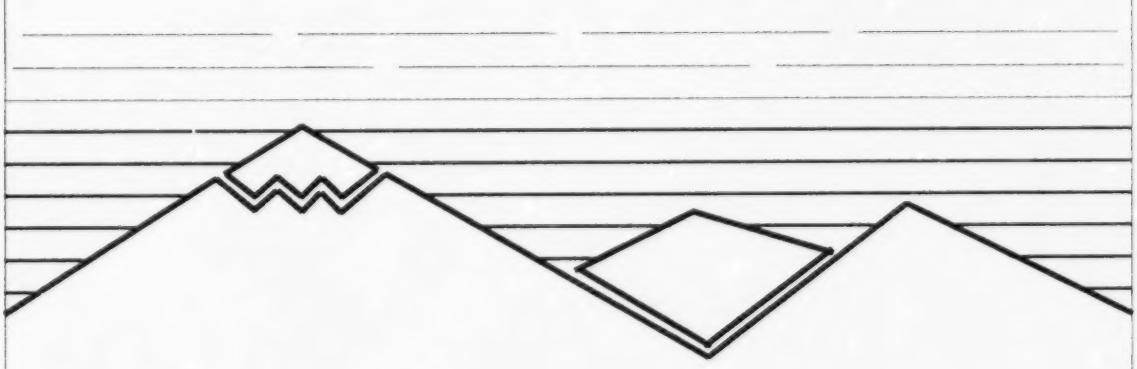
TABLE 4. Mean pool area, maximum depth, and LOD cover (± 1 SD) at LOD test sites in Southbay Dump Creek, June 1983 (one year post-placement) and July 1984 (two years post-placement)

Site type	No sites installed	No. sites still effective	Pool area created (m^2)	Maximum stream depth (m)	LOD cover provided (m^2)
			June, 1983		
Cross-stream LOD placements	7	7	14.8± 8.5	0.39± 0.15	7.7± 5.7
Oblique LOD placements	4	3	9.5± 9.0	0.32± 0.19	8.3± 3.8
Side pools	2	1	7.0± 9.9	0.28± 0.31	5.3± 0.6
			July, 1984		
Cross-stream LOD placements	7	6	14.6±16.4	0.44± 0.19	11.3±10.4
Oblique LOD placements	4	0	0.0± 0.0	0.19± 0.13	0.8± 1.0
Side pools	2	0	0.0± 0.0	0.11± 0.02	0.3± 0.4

FIELD TRIPS

Day 3

Thursday, October 23, 1986

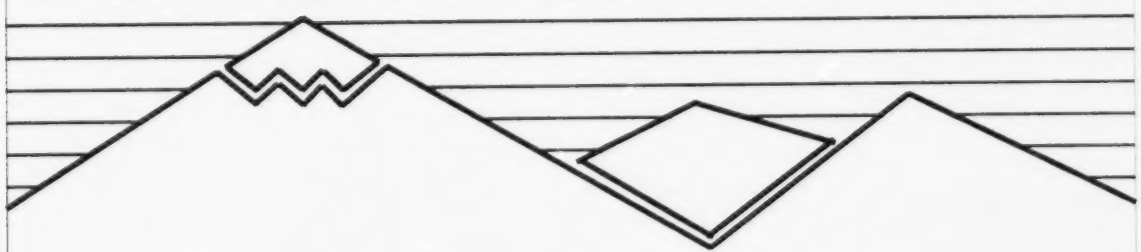


Each of the 12 working groups met all day for discussions on their topics and a field trip to streamside and hillside locations near Macmillan Creek

WORKING GROUP SUMMARIES

Day 4

Friday, October 24, 1986



Moderator for the day's discussions:

Rick Morley

Fisheries Branch
Ministry of Environment and Parks
780 Blanshard Street
Victoria, British Columbia
V8V 1X5

Working group leaders were asked to help direct the groups' discussions to each of the following questions:

1. What are the FFIP results which have a bearing on this topic?
2. What do these results mean to the topic?
3. What can we do with what we know now?
4. What results have been implemented already?

Note: MOE is B.C. Ministry of Environment, now B.C. Ministry of Environment and Parks
MOF is B.C. Ministry of Forests, now Ministry of Forests and Lands
DFO is the Canada Department of Fisheries and Oceans

Group One: Administration

Group Leader: Terry Dyer

Participants: John Cuthbert, Jim Connor, Colin Spence, Chris Dragseth, Dave Toews, Doug Cooper, Hank Hanson, Doug Rickson, Dave Narver

There were five areas of discussion noted:

a) the referral system. Is there enough time to address mass wasting problems too?

b) Five year plans and cutting permits. Is there enough time for reviews? Are map scales being used adequate?

c) protocol agreements

d) sensitivity mapping

e) subsidiary agreement

Notes on discussion relating to the above:

a) **The referral system.** The reporting structure and head offices for each agency is in a different place. MOE in Smithers, MOF in Vancouver and DFO in Prince Rupert. Industry would prefer that they report to MOE Vancouver. Fisheries have authority to make decisions on the Charlottes. MOF would like MOE to report to Vancouver, especially when the next level of responsibility that is required for decision is there, or have the authority for decision on the Charlottes. Turn around time for referrals and comments on five year plans is two to six months. Some blocks must be reviewed twice because blocks haven't been fully engineered for roads, yarding directions, landings and so on. In areas where fishery concerns are the only issue, MOE and DFO will accept the recommendation of the other agency, saving time. There is concern by the MOF and Industry of duplication in reviews of concerns by DFO and MOE (however MOE reviews wildlife concerns also).

b) **Five year plans.** There was concern that fisheries inventory isn't available prior to a five year plan. If the agencies had a long term plan of 10 to 20 years, then the fisheries inventory needs could be priorized. There was concensus that long term planning would ease the administration problems. Better inventories are needed on soils (for slope stability, with standardized stability classification for all companies), for slope sensitivity, timber supply, fisheries and wildlife values. Agencies should make their concerns known early so that

companies can address the concerns. For example, what factors go into a decision that would allow a rate of cut of 30%? Further concensus was reached on the continued importance of the five year plan as the approval process within a 15 to 20 year long term plan.

c) **Sensitivity mapping**. The companies have been left with the responsibility of the mapping. When the mapping is completed and the blocks are laid out, then judgement calls have to be made based on the maps. At present, multiple consultants and experts are brought into areas of dispute at great expense. A suggested change could be to have a field working group of experts that could be called in. Agencies and companies would have to agree on the members of the group as well as their findings.

Discussion on the Working Group questions

Recommendations made from FFIP's results:

1. Mapping of stability sensitive areas for the Charlottes. (This has been done to date.)
2. Recognize the option of not logging unstable areas and reduce the cut calculations. (This is being done when AAC plans are reviewed.)
3. MOE and Water Surveys Branch of Environment Canada should expand the stream flow and climate information available for field managers. This is being done on a limited basis; for example, from the Yakoun and from Pallant Creek. The completeness of the program should be received by TAC.
4. The methods in reviewing resource use tradeoffs need to be refined. This hasn't been done and more work is required. Economics and cost benefit analyses are required.
5. Watershed rehabilitation techniques should be standardized and recognized as standard procedure. Costs could be covered in stumpage fees. Examples of rehab techniques are putting roads to bed and grass seeding. There is a backlog of rehab work at present. Better pre-planning would hopefully result in appropriate and timely rehabilitiation (and prevention) techniques. Some drainages will require an additional commitment in completing rehab. Woods planning and adequate budgeting is needed to carry out the program and follow up. More specific details on rehab should be included in five year plans.
6. Housing, staff training and staff transfer policies should be structured to attract trained staff. Training has been cut back and transfer policies may still be a problem. Special training courses as a result of FFIP should be held on the Charlottes. Consideration should be given to an Industry/Agency exchange program. For example, Fishery Officers staying in logging camps on Vancouver Island.
7. The slope stability manual presented at the workshop should be completed as soon as possible with immediate operational field testing.
8. Further use of alternate logging techniques such as helicopter logging should be explored. Economics will definately play a major role in viability of alternate logging. Formal followup monitoring should be put in place to assess mass wasting after alternate logging techniques.
9. Areas needing large scale mapping should be determined and included in the five year development plan.

Group Two: Administration

Group Leader: Alan Edie

Participants: Ted Baker, Ray Travers, Dave King, Brian Bustard, Brian Downie, John Lamb, Jim Jackson, Paul Chapman

The following notes are from Alan Edie's summary of the working group's discussions which was presented to the workshop Friday morning:

AAC-TSA plans, Management and Working Plans:

a) appropriate deletions should be made by withdrawal of severely unstable sites.

b) accuracy of deletions should be checked at each AAC calculation by comparing classes of sites to be withdrawn from the inventory with the types of sites refused due to stability

Subsidiary agreement:

a) The group had mixed feelings on impacts of this and reached no real concensus. It was apparent that it is too early to know for sure how it will work out.

b) Some people felt that such agreements should improve the situation by increasing company accountability.

c) Others felt mass wasting problems would remains undetected more often due to fewer agency personnel on the ground.

d) Some companies prefer idea of moving decisions to Five year plan level, but info requirements at that level may be a problem.

Five year development plans:

a) The current emphasis on amendments is a problem for agencies but the situation is improving. There was general agreement that there is a need to get ahead of the game with planning.

b) A suggestion was discussed that the 5 year plan should include a road management plan in unstable areas, including post-logging road management. Responsibility for coast of raod rehab should be clarified.

c) Better fish habitat inventory would help 5 year planning, with the suggestion for emphasis on inventory in problem areas, possibly tied into slope stability problems. Perhaps there should be an inventory section on the Charlottes? Clarification needed for responsibility for costs.

d) There was a suggestion for pre-5 year development plan by watershed, to identify problems before the company invests in planning costs.

Protocol Agreement:

Generally the protocol agreement seems to work, but there was a feeling that some clarification of process at lowest levels would be useful.

Cutting permit referrals:

a) Some companies felt that system contains unreasonable delays.

b) The need for full engineering on all blocks prior to cutting permit application was dicussed at length. Reduction of engineering requirement in non-contentious areas was desired by industry. Fisheries agencies wanted to delay field work and final approval until after engineering.

Staff:

a) The group agreed that staff training is important, including a roads-to-bed course, and Bill Carr's material. Extension of FFIP will be important. Staff exchanges between agencies are positive and should be encouraged.

b) The possibility of putting MOF pedologist on QCI discussed and general feeling was that this would be positive The group agreed that measures to encourage competant staff to stay on the Charlottes are needed.

d) Expert staff on slope stability must be made available, and the choice of when they get involved is important. There is a need for more specialists 'on the ground'.

Miscellaneous discussions:

-mentioned pre-Five year plan (covered by Dyer's presentation)
-need to establish some way of rationally evaluating risks
-need for monitoring stream's reactions to treatments

Group Three: Planning and Assessment

Group Leader: Rob Pollock

Participants: Rick Morley, George Edgson, Paul Chapman, Tom Chamberlin, Paul Lawson, Louis Bourcet, Greg Savard, Dave Knapton, Donald John

The discussions noted were related to specific questions:

1. What were the FFIP results that were relative to planning and assessment?

-FFIP has provided knowledge about the causes and impacts of some slope failure processes.
-Many of the FFIP results confirmed previous observations such as those for road related failures.

-While it was felt that present techniques and experience in identifying potentially unstable slopes is good, the handbook is expected to help in the assessment phase.
-It was evident that foresters, engineers and biologists need the expertise of geomorphologists to explain and he
-Knowledge of rehabilitiation and prevention options will help in the evaluation of alternatives at the planning stage.
-Open slope failures due to root decay alone would seem to have few obvious solutions at the planning stage.

2. What information is lacking for proper decision making?

-Information is needed to help assess the 'risk factor' associated with unstable slopes, specifically the downstream extent of impacts on fish habitat as a result of upslope failure.
-It is important at the planning stage to assess the level of 'risk' for a given slope failure.
-FFIP didn't really provide information to help predict downstream effects of gravel/sediment changes upstream and upslope.
-Can we classify streams according to their level of impact risk?
-Streams differ in their ability to absorb impacts. Can we develop a 'durability index'?
-Perhaps Lee Beaven's data and results will help.
-more information (research) is needed on the subject of debris management in gully headwalls. Such as: Should debris be cleaned from gully or left in?
-LOD management was seen as a concern and clearer guidelines for planning LOD recruitment would be helpful.

3. What is being done already?

-There is good assessment of failure potential with use of slope stability maps and specialists.
-Road layout and engineering is being carried out in consideration of slope stability.
-Operations are scheduled to avoid sensitive arease during wet seasons.
-Attempts are being made to minimize road lengths and maximize deflection.
-Road construction and harvesting technique are being used to minimize slope failure. These techniques are being prescribed at the planning stage.
-Specific site analyses are being undertaken.

A general recommendation was made for the need to format the FFIP results for presentation as concise and accessible videos and training program.

Group Four: Planning and Assessment

Group leader: Gerry Johnson

Group participants: Peter Lewis, George Edgson, Don Howes, Dino Diana, Wayne Green, Steve Chatwin, Dick Smith, Ben Hansen, John Perras, Steve Pestell

Discussions were directed to several questions.

Objective

What is the objective of planning and resource assessment

- to plan resource extraction which will over time maximize the yield of the forest resource and maintain the fisheries resouce.

Are we meeting this objective today?

- No. There are impacts. Both forest site and fish habitat losses are occurring.

The Resourse Data Base

What types of information are needed for planning?

a. Terrain: Terrain type and slope stability maps
b. Fish: Fish habitat maps, showing limits of accessability of anadromous fish and reach characteristics; also use of reaches by non-anadromous fish.
c. Forest inventory
d. Topographical mapping

What is the level of detail required for each of these resource inventories?

The level of required detail is dependent on the level of planning (the operability assessment). The chart below shows the scale of the map, which determines the detail of information required for

the operability, the Five-year plan and the cutting permit stages of planning:

Resource	Operability Plan	Five Year Plan	Cutting Permit
Terrain	1:50,000[1]	1:20,000[2]	1:5,000*
Fish habitat	1:50,000[3]	1:20,000[4]	1:5,000*
Forest	1:20,000[1]	1:20,000[1]	1:20,000[1]
Topography	1:50,000[1]	1:20,000[2]	1:5,000[3]

*only needed in sensitive site areas.

What is the present availability of this information?

The superscripts in the chart above indicate the relative availability of this data for the Queen Charlotte Islands.

Code 1: readily available for most areas.
Code 2: available for about 50% of the areas
Code 3: partially available
Code 4: available in very limited areas only.

What are the problems to achieving the goal of adequate resource data?

a. There is a big gap in fish and fish habitat information at all levels of planning. There needs to be a commitment by someone (MOF? DFO? Licensee?) to pay for the acquisition of this data.

b. There must be a standardization of inventory methods between the various inventory collectors. At present, inventories are being conducted by consultants to licensees, in-house licensee environmental groups, federal agencies, and provincial agencies. The first two are the most active and have contributed by far the bulk of the data, especially at the more detailed levels of planning. However, there is no single agency coordinating this activity. The result is a confusing array of legends and classification criteria within each discipline. Provincial correlators should be appointed to ensure uniformity and quality standards.

c. There is an essential need for a central depository for all resource data collected on the Islands. Not even a catalogue exists of all the various inventories that have been done so far.

d. There must be communication of information that is available to all licensees and agencies.

e. There is an absolute need for sequential air photo coverage, coordinated at the provincial level conducted on a five year interval of all the Islands. The historical library should also be maintained.

What types of information needs to be researched or collected that is not presently available?

a. Stability maps: We need symbols showing the probability of landslide occurance and the probability of a slide impacting on a stream.

b. Fish habitat assessments: We need a system of relatively rating fish habitat.

c. Risk assessment: We need a method of assessing the risk of instream sedimentation on fish habitat, both within and beyond the scour zone. This is a knowledge gap that should be addressed through more research.

d. Fluvial geomorphology information: What are the impacts on bank stability and channel morphology of various logging practices and sediment inputs? How should inventories be conducted where there is no prior information? A reconnaissance through detailed sequence is best. 1:50,000 maps will identify parts of the watershed where more detailed 1:20,000 mapping is needed. Only very sensitive sites will be examined (but not necessarily mapped) with a 1:50,000 level of field checking.

Who should conduct resource inventories?

In the case of TFLs the data should be collected by the licensee or their consultant acting in close collaboration with their counterparts in the various government agencies. The agencies should, more strongly than in the past, coordinate methodologies; correlate between mappers; and act as a depository of the data. More structure is needed for all types of resource data.

In the case of TSAs the responsibility falls on the shoulders of the Forest Service.

Planning Horizons

1. The operability assessment

The operability assessment should be initially prepared by the licensee but then discussed and modified in cooperation with all affected government agencies.

2. The Five Year Plan

Site specific information is needed which must be collected by the licensee.

What types of information are often missing when Five year plans are collated?

- inadequate fish habitat information
- inadequate bank stability information
- the quality of topographic information is highly variable
- terrain and forest inventories are generally good

How can the Five year plan process be facilitated?

The joint evolution of ideas with the licensee and all the concerned agencies and MOF is the key. Agreement may require multiple meetings but a cooperative approach to identification of the problems, field assessments and solutions is necessary. There must also be a commitment on the part of all involved to make a decision within a reasonable time frame.

What impediments currently exist to reaching this goal?

-More industry-agency reciprocal trust is needed.
-There are inadequate numbers of agency personnel. The large numbers of permit applications simply cannot be handled in a thorough and speedy manner by one or two biologists.
-More timely planning by the companies is required to avoid the rush deadlines.

How effective can the above level of planning be in minimizing mass wasting?

Some of the licensees already have much of the resource data discussed above. Landslide surveys have also recently been completed on the Islands. A simple case study could be made assessing the incidence of landslides on the licensee's claim in areas where this type of planning process was used as compared to areas where it was not used.

Group Five: Roads

Group Leader: Erik Bentsen

Participants: Jim Schwab, Sandy McDonald, Del Pratt, Don Hoffman, Patrick Armstrong, J. Greenlee, Charlie Wilson, Dave Calder, Phil Cottell, Don Murray, Jim Connors.

A. Planning

The following items should be considered prior to any decision on road development:

1. Market or company specific timber requirements.
2. Timber inventory
3. Resource information: slope stability, fish and wildlife resource data, recreation, domestic water use, archeology, landscape management, joint tenure plans, stand history in the unit such as regen age, extent of harvesting, fires, blowdown
4. Block selection

When planning for road layout, consider:

1. Term of use
2. Equipment available for construction and
3. Stream recognition with critical crossing construction times etc.
4. Topographic features and ground conditions which determines yarding equipment -the type and feasibility
5. Class of road
6. Economic constraints

B. Road Layout

1. Stream and drainage identification:

Determine the stream reach classification which defines the importance of the fisheries resource and timing of constraints on the stream works.

2. Road construction:

Minimize the amount of road built on higher risk area within the limits of available yarding equipment. Control features to be indentified:

topography (benches, landings, switch backs, rock bluffs, bogs, etc), soils and bedrock, stream crossings, timber type boundaries, ballast sources, field identified stability problem sites, and fish habitat (such as back channels).

3. Road design:

a. Identify high risk areas which cannot be avoided and design measures for these areas such as:

- Avoid fills on steep slopes with end haul and full bench.
- Provide grade relief through gulleys to ensure any overland flows are directed into the gulley and not down the road if the culverts and ditches are plugged.
- Consider the use of geo-textile materials where appropriate.
- Plan the timing for carrying out special measures.
- Consider using specialized expertise such as geologists to assist in designing treatments for high risk areas.

b. The risks in the road design must be recognized by resource people and there must be an acceptance of the proposed plan.

C. Road Construction Phases

1. Filling:

-Limited options are available due to right-of-way width.
-There is a need for flexibility in right-of-way widths to suit the terrain.

2. Subgrade:

-Flatland areas have fewer problems and different concerns than sidehill areas.
-The operator should remove overburden and place it on stable ground.
-Avoid overloading downslope.
-Avoid undercutting the upslope as far as is practical.
-dentify any new drainage structures.
-Put in wood culverts, ditches and openings for metal culverts at this point. Backhoe construction now permits the establishment of drainage structures at depths below the subgrade level. Wood culverts are preferred for new construction in that they are less easily damaged during logging and they tend to have larger opening size. However the choice of material must be site specific. It is critical to provide drainage structures to handle the indicated and the calculated water flows. The distance that ditch water is carried should be minimized.
-Avoid spilling culvert water out onto earth fills.
-Limit fills in gulleys.
-Keep initial grade rock shots small until the driller has a good feel for how the rock will react.

3. Surfacing ballast and pits:

- In developing pits it is important to place the overburden in a stable location
-Keep the initial quarry shots small until the pit is developed to avoid overshooting.
-Manage road surface siltation by using the most competant locally available rock or gravels.
-Use geo-textile materials for filtering and stabilizing roads where justified or use the best economic alternative.
-Consider the use of new equipment such as Volvo dumpsters which provide more flexibility; for example, in end hauling.

4. Drainage structures:

-Maintain the natural water flow through adequately sized structures and proper positioning.
-Avoid spilling water out on soil fills.
-Maintain the natural ground profile on culverts where fish are involved.
-Dissipate water energy at the culvert outlet.
-Use settling ponds at the headend of culverts where suitable.
-Consider hydroseeding ditch lines in areas of silty soils.
-Consider the use of grizzlies on a site specific basis.

D. Road Maintenance

1. Active roads:

-Maintain ditches and culverts on an ongoing basis.
-Train grader operators to crown the road and avoid the creation of berms.
-Clean out ditches and culverts after logging or brushing work.
-Consider using markers along the road to help crews checking culverts and to avoid damaging culverts with graders and other equipment.
-Checking and cleaning culverts should be everyone's responsibility
-Major drainage structures should receive regular detailed inspection.

2. Inactive roads:

An inactive road is a road that will be used again for logging. The decision to abandon or maintain must be site specific

-Set up a regular ditch and culvert maintenance program.

where the risk is high or the cost of moving maintenance equipment in, is high.

-How will the costs of road maintenance be recovered? Possibly through Section 88 or some other funding? There was some discussion on the need to have a commitment to maintain inactive roads to an acceptable standard and a mechanism for funding this through Section 88 on the Appraisals System.

3. Abandoned roads:

These are roads which will not be required for vehicle access.

-Identify high use areas and consider the use of the following techniques: removal of drainage structures; retrieval of fill and sidecast; build water bars and open-faced culverts. There must also be a commitment for funding this work for Appraisals allowance, Section 88 or another fund. Common sense must be used in the application of the treatments.

Group Six: Roads

Group leader: Trevor Boniface

Participants: Bruce Thompson, Ken Anderson, Dick Kosick, Bud Iverson, Dennis Rowse, Debby Gardiner, Dennis Smith, Cec Baldry-White, John Standish, Jorma Jyrkkanen, Dionys de Leeuw

Reducing mass wasting due to roads in logged areas on unstable terrain.

1. During the planning stages:

-Identify all drainage patterns.
-Identify sensitive areas such as gullied terrain, active and inactive failures.
-Identify areas with more than 60% slope on topographic maps.
-Consider bedrock and surficial geology and geological processes where necessary and classify them.
-Consider the volume and quality of timber to be logged.
-Consider the logging systems available.
-Identify the other values.
-Identify known fisheries resources and plan for joint development of a fisheries resource map.

2. During the engineering stages:

-With the above information, do a layout avoiding as many of the sensitive areas as possible.
-Consider all the alernatives available in super-sensitive areas.
-Consider steeper grades to avoid the sensitive areas. Ensure that wood culverts are used and are properly located.
-Design grade breaks at cross drains where possible.
-Design areas for maximum opening to reduce fringe windfall and maximize the amount of timber developed per kilometer of road.

3. During the road construction stage:

-Do not incorporate overburden into the subgrade.
-Cast the sidecast material uniformly and as widely as possible to disperse the load on the sideslope.
-Consider full bench cuts near problem gullies or on steep slopes.
- If the road is close to important fish creeks, consider end hauling.
-Keep water out of sidecast shear plane.
-Try to confine the landings to stable areas.
-In U-shaped gullies, fill the gully with clean shot rock and dip the crossing for water and possible debris trickle
-As an alternative to end hauling near problem V-shaped gullies leading to fish streams, use shot rock and large span culverts. Backcast on approaches.
- For throughcuts, ditch on both sides.

4.Hydrology and active road construction

-Ditches require proper depth and width.
-Crown the road.
-There should be no berms on the road.
-Use wood culverts, and oversize or extra culverts if necessary.
-Make a catch basin at all culverts to collect silt and debris.
-Use mud sills on culverts with erodable soils.
-Water should be kept in all its natural courses, with no ditching of intermittent creekd
-Make sure that the water flows into the culverts, not passing the culvert and flowing down the ditch.

5. Road Maintenance

On active roads:

- Retain the integrity of the road surface drainage structures and the water quality.
- Ensure that berms are removed and that the road is crowned.
- Conduct maintenance inspections prior to long shutdowns and during peak flow periods.
- Do not carry out maintenance during heavy precipitation unless it is essential to do so.
- If slopes are eroding and quick regeneration of vegetation is not likely, plant or seed if necessary.

On inactive roads:

- Priorize the roads for future requirements.
- For non-essential roads, remove culverts and make deep cross ditches where required.
- Roads that are required for future access for silviculture or fire access should be put to bed but still passable.
- When cross ditching, channel the water only into established channels or stable slopes.
- Roads should be put to bed as soon as possible after the completion of logging.
- We require a handbook or operator's guide for putting roads to bed.

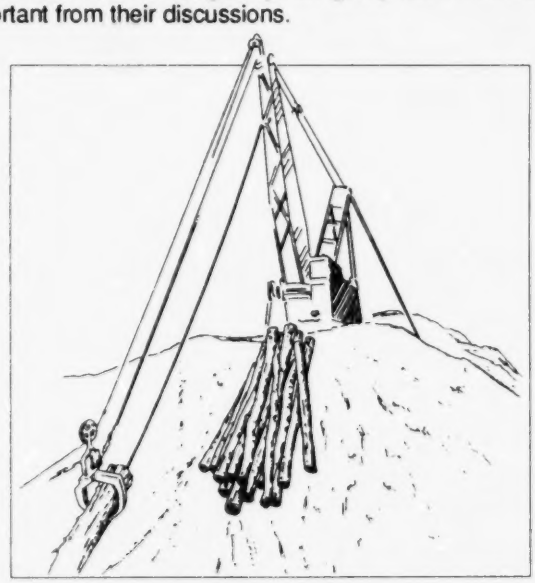
Note: We require a resource inventory of fish habitat to analyze downstream impacts, followed up with future research on impacts and implimentation of rehab if downstream impacts are significant.

Group Seven: Active Logging

Group leader: Doug Mosher

Participants: Tony Sauder, Forbes Boyd, Doug Morrison, Duane Gould, Ted Kimoto, John McLaughlin, Lyle Enderud, Ron Jordons, Victor Fradette, Fred Hutchison, John Errico, Terry Rollerson.

The following summary was discussed at length by the group and contains the points that the group decided were the most important from their discussions.



1. There is no question that the most important aspect for environmentally-sound, economic harvesting is good layout, resulting in good deflection.
2. To ensure that plans and agreed-upon activities are put into action, company foremen and field workers, not just the overseers, should be trained to identify problem sites.
3. On the Queen Charlotte Islands, there is concern that mass wasting transports debris within gullies. Excessive debris within gullies can influence the management of failures, act to trap sediment within the gullies, and act to inhibit erosion of landslide deposition zones. Generally we should attempt to minimize the introduction of logging debris into our gully systems. However, the decision to allow the introduction or prevent the introduction, to remove or not remove the logging debris should be site specific. The likelihood of deposition at the point of entrance into the streamchannel versus transport down the stream channel is also a consideration. This entire gully topic should be researched further.
4. Future research should specifically consider slope stability prediction and the travel distance

of landslides. In the meantime, we should use the currently available information.

5. Research on the potential of selective harvesting to maintain slope stability should be undertaken. That is, what are the long-term effects of selectively harvesting high-value timber on steep slopes using aerial logging systems?

Group Eight: Active Logging

Group leader: Ray Zimmerman

Participants: Mike Brownlee, Dave Jones, Joe Ronyecz, Susan Craven, Damian Keating, Ralph Backer, Dennis Girodat, Dennis Girodat, Frank Boise, Alex Sinclair, Bruce Storry

1. The group decided to limit their discussions to the falling and yarding phases of logging.
2. The trend in yarding systems is to using yarding cranes. There should always be a mix of techniques so that an operator can match the best system to the terrain. The new generation of yarding cranes have a longer reach and higher speed and are changing logging planning.
3. Clearing gullies should be site specific. Gullies should be classified to determine the likelihood of a stability problem developing. Classifications could include: wet or dry gully, debris size, stability of debris, and channel width. These classifications could be used to determine the likelihood of debris flushing into a stream.

-It is not clear what should be done with gully logging, other than using site-specific prescriptions.

-The use of the excavator/backspar technique in gully logging should be monitored.

-Directional falling can help reduce gully loading and stump removal.

There was further discussion of gully debris. If it is not transportable then it should be left in place to minimize water erosion. The key is to not add more debris to the gully during logging. If the debris is causing or has the potential to cause damming of water, then it should be removed. However, removing the debris itself may create instability.

4. There was discussion on the referral process in the approval or lack of approval of logging plans. If there is disagreement among technical people then it is usually based on differences in assessment of risk.
5. Further FFIP research could be done on overstocking gullies with new trees to see if the trees can buld up a greater root system and reduce the likelihood of a slide.
6. There is some very difficult logging on the Queen Charlotte Islands and a key to good planning is to get information on techniques out to the loggers working in these difficult areas.
7. The group supported the idea of a FFIP handbook but suggests that the manual should be accurate, simple, waterproof and small in size.
8. Some experiments should be going on right now on current logging systems as it will take 5 to 10 years to see results of those experiments.
9. There should be incentives for companies to experiment or try innovative techniques in high risk areas and there should be a means of increasing the technology transfer about innovative techniques between companies working on the Islands.
10. Good logging planning can avoid a lot of problems.
11. Maintenance of roads has not improved to the degree that road construction techniques and application of engineering have.
12. The problems due to poor road maintenance on the Queen Charlotte Islands are perhaps less prevalent than elsewhere.
13. The engineering, management and field crew must all be well aware of the potential problems and the techniques of operating on sensitive sites.
14. Agencies should be on site at development areas at least once a year to view problem or concern areas. Sometimes there are problems with different levels of responsibility in the representation from companies and agencies.

15. A baseline study should be started to monitor new techniques and equipment and monitoring of the FFIP study sites should continue. Five years is not long enough to evaluate mass movement.
16. A sense of pride in workmanship should be instilled in all workers, particularly when reducing problems associated with site disturbance and road maintenance.
17. Rehabilitation projects on torrented streams should be considered. Should workers remove known stream 'timebombs' before starting rehabilitation projects?
18. Why not log the Phantom or Hangover Creek areas that were inventoried in detail during FFIP, using them as test research areas?
19. Residuals could be left standing or areas could be underplanted before logging in certain areas in order to maintain the root net. Some productivity would be lost with these methods.
20. Shrub alder and perhaps Sitka spruce should be tried as a slope stabilizer.
21. Every site is different and systems and techniques must adjust to the specific site.
22. Intermediate spars and European long line systems should be tried on sensitive sites. Corridor logging with side blocking may be applicable.
23. The amount and quality of LOD required in streams was discussed. Why do we leave LOD trees standing along streams? There should be work done in FFIP II on LOD in the streams. What role does gully debris play in LOD?
24. FFIP II should look at the amount of material that will be moved in a debris torrent.
25. The timing of falling and its affect on the life of the root system should be looked at in FFIP II.
26. The information from the FFIP work has more applicability on the south coast than vice versa. The parameters of the FFIP study must be kept in mind when any of the FFIP research results are being applied to other parts of the coast. There was concern about how results from Queen Charlotte Islands' studies are reported or implemented in other areas.
27. These FFIP results are relative to active logging but the present FFIP information could be upgraded to reflect new or different QCI logging practices. The FFIP work was a directed study, not a random study.
28. When putting changes into practice, the most emphasis should be put on changes which will achieve the most benefit. Road engineering, construction and maintenance will generate the greatest returns.
29. What are the confidence limits of the FFIP results? There were some questions raised about sample selection.

Group Nine: Silviculture

Group leader: John Duncan

Participants: Dave Winston, Peter Sanders, Dave Wilford, John Leesing, Steve Willis, Gilbert Brennenstuhl

Working group objectives:

1. to give direction to FFIP
2. to develop silvicultural suggestions or direction to ameliorate the impact of forest operation on the fisheries resource on the Queen Charlotte Islands.
3. to develop a cooperative inter-resource dialogue and trust
4. to identify acceptable impacts on the fisheries resource

Notes from the general discussions:

1. Mass wasting has a fisheries impact and results in loss of forest productivity. It is however a natural event which is exacerbated by logging.
2. Recognition of danger areas is relatively good with terrain mapping techniques but we need to develop identification techniques for specific location problems such as in gullies.
3. We need to get prompt regeneration. We need to plant danger zones with fast growing

species, especially deep-rooted, easily-accessable species such as spruce, alder and cedar. Research is needed to clarify 'plug' versus 'bare root' planting stock and to identify deep-rooting, fast-growing species.

4. We need to look at ways of altering Class 5 sites with natural stands so they don't slide down onto plantations below. 'Trigger trees' in danger areas should be knocked down to help reduce the risk of setting off slides in slope backlines and gully headwalls.
5. Mistletoe in mature stands can infect adjacent regeneration. This makes it difficult for us to justify harvesting techniques other than progressive clearcutting.
6. Are the modified harvest techniques viable options on slopes?
7. The timing of the cut influences the root bark sloughing and therefore the holding ability.
8. Helicopter logging on unstable areas can be used to reduce road damages. Only a percentage of the trees are taken to allow residuals to retain their root mat stability.
9. Gullies are the most critical feature. We must keep water from roads out of them. They are harsh growing sites, often with shallow soil. We need to learn how to manage them. Shrubs do not seem to revegetate gullies quickly. Experiments with deer exclosures to permit shrubs to grow should be done.
10. Economics seems to control the silvicultural process.
11. The group endorsed the need to put roads to bed and the need for regular road inspections to look for potential failure spots even after the roads have finished their usefulness.
12. The group endorsed the need for roadside vegetation covering of grasses, legumes, and alder. There was concern that alder can't be found above one thousand feet in elevation.
13. We should consider taking a risk on harvesting unstable areas that are remote from fish streams. Avoid harvesting slopes that are close to streams. We should try to do an experimental shelterwood cut in a localized situation.

A problem analysis: What do we need to know?:

a. What is the extent of landslides on cutovers that affect streams?
b. What is the extent of the landbase taken out of production by non-regenerated landslides?
c. How much timber is tied up due to proximity to watersheds? Could silviculture open up timber for harvesting on hazard zones?
d. streamside silviculture

Identification of sensitive sites can be done on a broad basis but it is more difficult to do on an intensive basis due to higher costs and so on.

Once the sensitive site has been identified, decisions must be made based on the options:

a. shelterwood harvest of the specific site to develop regeneration (10-15 year old) root mat. *The feasiblity of this needs to be demonstrated.
b. no harvest
c. clearcut
d. other modified cut system

After harvest, we need to examine immediate cover and planting of the cutover areas, and rehabilitation of any slides that may occur to prevent any further deterioration, with special attention to the following:

a. sites at the margin of the cutblock;
b. fertilizers and root stimulants to increase root development and slope stability;
c. the correlation between harvesting date, root sloughing and landslides;
d. plug versus bareroot planting stock for best root egress;
e. root grafting: What species does it occur in? How long does it take to develop? How dense should the trees be for grafting to occur?

Questions about streamside harvesting:

a. the LOD supply
b. water temperature, shelter
c. streambank and root stability
d. the retention of alder seed trees on streamsides: Why do we save alders as they cause a lot of concerns forest managers in vegetation control and access to conifers.? Alder's value to the streamside should be measured.

Conclusions presented from the discussion notes:

1. The group agrees with the desirablity to provide an interlocking root mat on slide-prone sites through precut and postcut methods. Most of

the following suggestions require further research:

a) shelterwood precut treatment
b) immediate planting after cutting
c) exclosures for regeneration and shrub protection from deer
d) seedling studies on species, plug versus bareroot stock, and root grafting for maximum root growth
e) study of root sloughing in relation to harvest date
f) edges of clearcuts
g) fertilizing and growth hormones to stimulate rooting

2. The group did not feel that it was reasonable to treat gullies as distinct silvicultural identities.

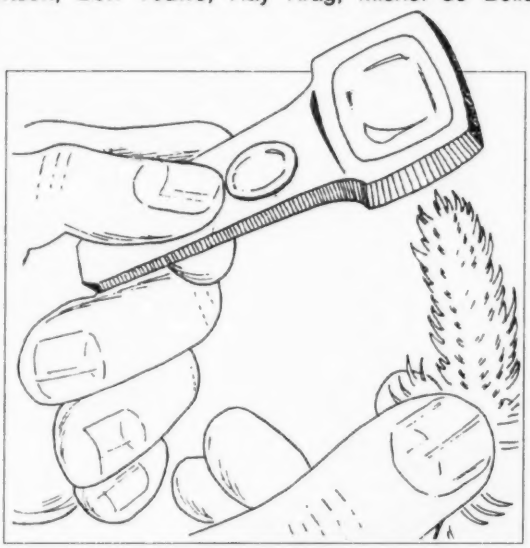
3. Rehabilitation of road sides and landslides should continue, to minimize further erosion.

4. The necessity of retaining streamside alder seed trees must be investigated. This project holds the best potential for the economic impact and benefit.

Group Ten: Silviculture

Group leader: Sylvia von Schuckmann

Participants: Brian Robertson, Don Youwe, Ray Krag, Michel de Bellefeuille, Grant Scott, Bruce McDonald.



Summary from group discussions:

1. One of the four overall objectives for the FFIP program was to "assess alternative silvicultural treatments for maintaining and improving slope stability".

There were no research studies conducted under FFIP to assess silvicultural options for unstable areas. There was however, a problem analysis prepared on the subject. This work is a very small part of the total research produced by FFIP ($11,000 of the total FFIP budget of over $1 million).

2. Our discussion group reviewed the problem analysis prepared by Sanders and Wilford (1986) as well as the FFIP results as presented at the workshop. Discussions focused on the applicability of the information to silvicultural practices which are or could be used on the Queen Charlotte Islands to improve and maintain slope stability.

3. Silviculture was defined for the purpose of discussion as the 'art' and science of vegetation managment used to establish, grow and harvest forests.

4. Based on a review of areas of particular instability identified by FFIP studies which can lead to mass wasting, the group noted the following silvicultural efforts currently made to stabilize problem or potential problem areas:

a) Technology for road building has improved. Through application of proper road location, engineering and construction, the potential for road failures and mass wasting has decreased with current practices. With proper road maintenance or putting roads to bed, access can be maintained for further silvicultural treatments. These practices are encouraged where they are not currently done.
b) Some companies are undertaking planting of slide areas. Alder is left to stabilize unstable

areas. Similar programs should be adopted by companies not currently doing such work.

c) Windthrow problems are considered in all logging prescriptions. Clearcut boundaries are located to minimize blowdown. In addition, development of clearcuts along one side of streams, while leaving the other side unharvested minimizes windthrow.

5. While these silviculture prescriptions are an improvement over past practices that lead to mass wasting there is considerable need for additional research to ensure protection of fish habitat and the forest land base. We suggest the following research areas:

a) impact of forest harvest timing on rootmat decay and the contribution to clearcut failure.

b) root growth of different species of deciduous and conifer trees and their role in re-establishing and/or maintaining rootmats for soil stability in clearcuts and streambanks.

c) long-term sources of large organic debris from silvicultural practices used in old growth and second growth stands.

d) a series of demonstrations are suggested to show the result of selected silvicultural practices as described by Sanders and Wilford (1986).

e) investigation of the role of alder in affecting silvicultural management (as described by Sanders and Wilford (1986)). We should look at the benefits of alder, something that is generally overlooked.

f) monitoring of silvicultural implications of helicopter logging in potentially unstable areas (both hillside and streamside) in the Davidson Creek area.

reference cited: Sanders, P.R.W. and D.J. Wilford; 1986; Silvicultural Alternatives for the Management of Unstable Sites in the Queen Charlotte Islands: A Literature Review and Recommendations; B. C. Ministry of Forests and Lands; Land Management Report No. 42.

Group Eleven: Rehabilitation

Group leader: Kerry McGourlick

Participants: Robert Laird, Doug Golding, Glen Carlson, Herchel Boyston, Doug Erickson, Eero Karanka, Gordon Kosakoski, John Payne, Peter Bruce,

The group defined their topic of 'Rehabilitation' as: the process of putting and keeping a disturbed site on the path to its former level of stability and productivity that will satisfy the objectives of multiple resource management.

Planning

1. Rehabilitation should be planned for, so that it is a part of ongoing operations, and is not being 'added on' after normal operations or after slide events. Potential rehabilitation problems should be identified at the five-year plan or the cutting permit level.
2. Stability mapping should concentrate on Class 4 and 5 slopes.
3. Planning for rehabilitation should not concentrate on single major events to the detriment of a comprehensive program for a watershed.
4. Rehabilitation should consist of a combination of preventative and rehabilitative efforts.

Preventative rehabilitation

1. It is better to concentrate on preventative rehabilitation rather than trying to patchup things after major events.
2. Road maintenance, roads-to-bed programs and existing reforestation practices are a form of rehabilitation but are directed to road maintenance and future timber production, not to slide prevention.
3. Attention to the maintenance of root networks on steep slopes is critical.
4. Modification to some existing silviculture techniques (such as larger planting stock, denser planting, tree fertilization) may be useful. Avoid burning on unstable slopes.
5. Roads-to-bed timing could be improved to get immediate preventative benefits.

Hillside rehabilitation

1. One-third to two-thirds of existing slide areas are suitable for manipulation.

2. It is important to stabilize hillside disturbance because of the continuing downslope effects of the disturbance.
3. Existing techniques such as water diversion, slope shaping, seeding and hydroseeding, mulches, geotextiles, and planting of trees appear to be successful.
4. Operational trials should be encouraged to build our experience.

Stream rehabilitation

1. Before work begins, the stability of the upper watershed and the various impact zones should be assessed, as well as the opportunities for rehabilitation.
2. The timing may not be right immediately after the disturbance.
3. Available resources should be priorized to locations where the best value for funds will be obtained, not only between affected areas in a stream but between streams. Lower reaches will give the best returns.
4. Emphasis should be on re-creation of natural habitat rather than on semi-aritificial production means such as incubation boxes.
5. The importance of LOD is evidenced by the most successful rehabilitation sturctures being those which simulate LOD.
6. The demonstrative value of rehabiliation work is high and early efforts have spinoff benefits for the future.

Suggestions for more work:

a. develop silvicultural techniques that promote rapid root generation on potential failure slopes
b. investigate the effect of juvenile spacing
c. develop silvicultural prescriptions for gullies
d. develop procedures and criteria to assess rehabilitation develop better communication about rehabilitation efforts and results.
f. explore the use of offchannel habitat creation

Conclusions:

a. Rehabilitation is not an 'after-the-fact' thing.
b. Local rehabilitation is in its infancy but we do have the tools for it.
c. Some experimental trials should be set up.

Group Twelve: Rehabilitation

Group leader: Al Cowan

Participants: Vern Wellburn, Juanita Ptolemy, Dave Lindsey, Dave Bustard, Cliff Valentin, Ian Williams, Charlie Scrivener, Keith Illingworth, Russ Jones, Kate Sullivan

The goal of the group was to: examine the rehabilitation of sites impacted by forest management of hillslopes.

The group felt strongly that **prevention** should be the primary goal of management strategies through planning, not simply a solution to a problem after it has occurred. Rehabilitation should be viewed as a bandaid approach not a cure.

1. How do we recognize what to rehabilitate so we can priorize our efforts? By sensitive watersheds, site productivity or blanket prescriptions.

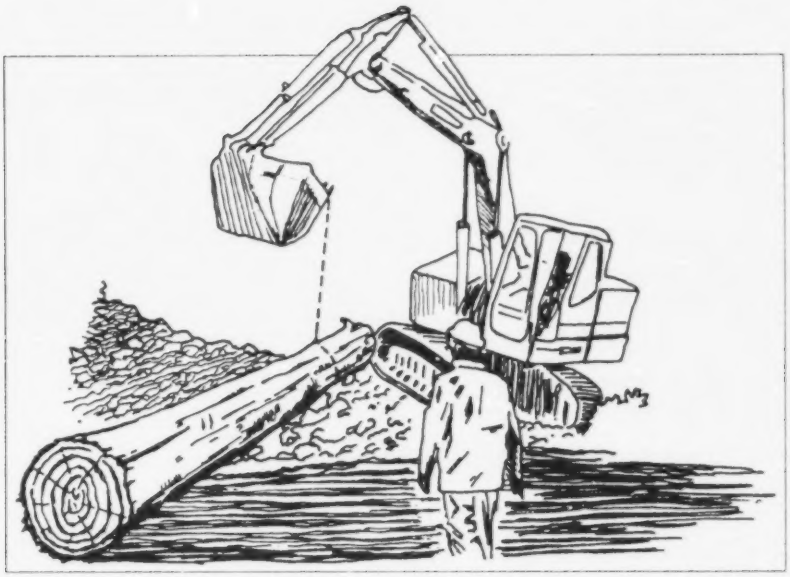
Our conclusion was that there is a **major need** for a system to priorize efforts.

2. What techniques do we use to work on problem areas?

The necessary information probably exists but we don't have a complete bag of tricks. More research is needed as well as more sharing of information among agencies about what works and what doesn't work. A handbook is needed. Gully treatments demand attention, particularly the means for predicting problem gullies.

3. How do we evaluate our success?Do we know or can we predict how effective our rehabilitation effort is in terms of our priorities?

1. FFIP did not clearly identify this aspect. Feasible techniques were demonstrated but can we apply a cost-benefit analysis? FFIP concentrated too much attention to torrented streams. It is more important to concentrate on debris placement in channels with less than 3% slope which we see as workable productive sites.
2. Offchannel habitat improvement should be explored.



3. Can we recognize the 'stressed' stream? When is enough, enough for a stream?
4. Bottlenecks to fish production are critical in the priorization process. Rehabilitation of landslide scars for forest site productivity does not merit high priority but reforestation of sensitive sites to close the window-of-sensitivity is very important.

Conclusions:

1. Where is the fine line between rehabilitation and prevention?
2. FFIP did not identify methods for priorizing either prevention or rehabilitation techniques.
3. The role of research is to evaluate techniques and their effectiveness to fill information gaps. Resource agencies and forest companies must be involved with this, for setting priorities.
4. The group strongly agreed with Bill Carr's closing remarks about landslide scar rehabilitation: policy is needed, funds must be applied, and better rehabilitation techniques are needed to provide a broader array of tools.
5. The most valuable benefit from our group meeting was that agencies are talking together.

Panel Discussion

Moderator: Rick Morley

Panel members: Terry Dyer, Al Edie, Rob Pollock, Gerry Johnson, Erik Bentsen, Trevor Boniface, Doug Mosher, Ray Zimmerman, John Duncan, Sylvia von Schuckmann, Kerry McGourlick, Al Cowan.

Some notes on the questions, answers and comments made during discussion to the panel of working group leaders follow:

Comment: About the risks to workers dealing with the new procedures proposed by FFIP and stressing the need to train crews in new techniques.

Comment *(from Ted Baker):* About removing gravel from an overloaded stream as a rehabilitation technique, "It is hard to get roads in to streams. There are lots of QCI timebombs here when the gravels are freed-up after debris rots which will bring problems with dewatering."

Question *(from Vern Wellburn):* In the long term plan, for deferring areas of stability, are we just passing along the problems by saying it can't be logged now?

Answer *(from Gerry Johnson):* There is a problem in isolating timber patches for flood plain protection. If areas are inoperable, they should be removed from the AAC."

Question *(from Doug Morrison):* Where will FFIP be going with further research, specifically with questions raised about streamside alder? We know alder is beneficial to fish. How much streamside alder is a seed source? How much hillside alder is the seed source? We need to reduce the seed source yet maintain the root wad of riparian vegetation. We need to compromise between alder control and root mass maintenance. Try the coppice technique? Maybe we should get some work going on Vancouver Island to compare to research on QCI.

Answer *(from Rick Morley):* We are gathering ideas for FFIP II.

Comment *(from Charlie Scrivner):* We are taking large trees from streamside with helicopter logging yet the streambank maintenance is important. The only thing holding the stream bank is alder and this definitely needs to be considered.

Question *(from Russ Jones to Gerry Johnson):* regarding long term planning. FFIP is a good step but limited in scope with focus only on landslides. The stream rehabilitation results are positive and in workshops, the perspective on the problems was broadened in the administration and planning sections. Who are we managing the resource for? We need to develop solutions to overall problems like sustained yield, for future economic bases in fisheries and forestry. We need a long term plan for watersheds for prevention of problems rather than trying rehabilitation to go back to natural conditions. Is there the possibility to address the motherhood issues?

Answer *(from Johnson):* The AAC is being adjusted to remove sensitive areas.

Jones: Yes, but can there be radical alterations in the system? The five year plan is too short term.

Johnson: We're getting into the political arena here. Once addressed there, radical changes may be possible.

Jones: What are the potentials for changes in silvicultural techniques?

Johnson: There is potential for research into methods that Sanders suggested. These are still in the formative stages. Ten years ago, we didn't even know how to ask the questions. Open minded discussion is perhaps the best approach.

Question *(from Tom Chamberlln):* Who's going to pay for these changes?

Answer: There's no economic analyses, as a research topic, on the implications of the suggested changes. What're the cost implications of not having the staff to make decisions quickly?

Comment *(from George Edgson):* There could be cost savings from spending money. It makes good sense to look at investing to save money and use resources more effectively to apply the information we know now.

Question: Yes but what about this economic analysis as a research project?

Answer *(from Rick Morley):* It is a difficult issue to address. What about in the FERIC studies?

Comment *(from Tony Sauder):* It was in the initial guidelines. We're not dealing with average costs so costs are higher. The details of costs were not compiled in the yarding studies.

Question *(from Kosick):* The costs of work will rise over time so predictions will be different over time. Would a long term road management plan fit into a management working plan level?

Answer *(from Alan Edie):* It would be specific to

unstable areas and more specific than working plan level. It could be dealt with it to some extent through guidelines but there is still a decline in agency staff over time, to deal with these problems.

Question *(from Tony Sauder):* There has been changes in input of information to planning for logging but no followup in most cases. For example, did slope stablity mapping help? How was engineering of the road location? There is no formal followup method.

Answer *(from Alan Edie):* We did strongly support the requirement for monitoring to start the learning process.

Comment *(from Chris Dragseth):* Our group also recommended follow up on effects of helicopter logging.

Comment *(from Gerry Johnson):* We always wanted a monitoring of forest engineering. There's a lot to be learned at minimal cost.

Comment *(from Travers):* We've just justified increased budget. We should try to monitor our techniques. Have we improved? If not, more research is needed.

Question *(from Alan Edie):* Are our prescriptions being followed and did they work?

Answer: Other work demands have limited our followup. We end up "fire fighting" due to the restrictions of staff and budget cuts.

Question *(from Hugh Sutcliffe):* Re the costs and viability of helicopter logging. Our costs are paid by the value of the wood. For alternate techniques, we have to look at the value of the wood we get out. For helicopter logging, it's the value of the wood that drives the alternate method. Helicopter logging is used in a very small portion of the areas cut and only in the extra high value areas. The coast will remain 99% clearcut logging methods in the foreseeable future.

Comment *(from Zimmerman):* It will take an increase in the value of wood to make helicopter logging viable over a wider area.

Comment *(from Lawson):* Helicopter logging makes unaccessable areas accessable for selective logging.

Comment *(from Sylvia von Schuckmann):* These alternative methods are what Peter Sanders suggested when he said we should use site specific tools.

Comment *(from Gerry Johnson):* Companies are not likely to waste money on uneconomically viable alternate logging systems.

Comment *(from Patrick Armstrong):* Stressed the QCI economy is focused on the resource base and was glad to hear positive prescriptions on road mangement.

Comment *(from Jim Henry):* We need a press release to show the public what resource mangers are now doing to manage resources with a profile of technology, so people can be more aware of what's being done now. What we' re after is stability in the stream system and it doesn't necessarily need to be LOD. Discussion then followed on the LOD sacred cow.

Comment *(from Vince Poulin):* Experiments have been done in Japan using cement blocks to stabilize channels. Artificial logs may be an alternative.

Comment *from Tony Sauder):* There are areas where alternate specialized yarding systems, such as helicopters, will operate better than the conventional systems. However, caution must be exercised where selective openings or other special treatments are used, not to produce adjacent areas that are uneconomic to log. Areas that are defined as economically inaccessible to road construction are the best. Marginal stands that have only their higher volume timber removed will become truly inaccessible for the future. Care must be taken not to increase the area of inaccessible timber through selective logging methods.

WORKSHOP COMMENTARY

by Bill Lefeaux-Valentine

Although I had some reservations about taking the time to attend a three day workshop and providing a summary commentary I decided to participate because this program is an essential ingredient towards developing a balanced perspective regarding resource management conflicts for the two most important industries on these islands: logging and fishing. It is a privileged position to be provided with the opportunity to attempt to capture the mood of this meeting. I was advised by one of your colleagues that my success would be determined by how you left this final meeting: 'hand in hand' or 'knife in back'!

Before I proceed with the commentary it is appropriate to note that one's perspectives are shaped in some fashion by your own values and experiences. You should know what concerns mould my views and result in my presence here.

In order to sustain my very small community (Queen Charlotte) and the rich values inherent in living in small rural communites, a viable economic base is required. My own observations have led me to presume that a community with a deversified economic base is generally more resilient than a single industry town. Communities on the Queen Charlotte Islands have the potential to reap the benefits of at least two resource industries that are sustainable. We do two things quite well here: growing trees and raising fish. Trees and fish provide me with an income in almost equal proportion. Since trees and fish then do represent significant sources of wealth to various communities in different proportions it is important that we do not minimize or trivialize the value that one resource means to a particular user other than ourselves or our immediate community.

Continually in the workshops discussions I observed the question of economic reality; profitably harvesting trees in more remote topography, brought the comments back to realistic problems. The discussions that proved most worthwhile were the ones that focused on real problems being experienced in the industry now. These discussions were also a frank reminder that this workshop is not concerned with hypothetical problems of a distant future but with some of the consequences of our present approach to harvesting timber on steep slopes. All of our discussions are of little value unless harvesting alternatives are developed that can be implemented at the operational level.

Another concept explored in the workshops and the plenary sessions was the issue of 'economic trade-offs'. Simply, at what point does the value of the harvest of trees outweigh the value of fish habitat which may be lost due to stream deterioration as a consequence of disruption to a watershed or, when does the value of fish habitat exceed the harvest of a particular stand of trees?

As a member of the Northern Panel of the Pacific Salmon Commission (charged with the responsibility of implementing the terms of the Pacific Salmon Treaty between Canada and the United States) perhaps I can give you some estimate about the value of the 200 - 250 salmon rearing streams on these Islands.

In 1985 the fall chum and coho net harvest had a value of between twelve and eighteen million dollars. The value will vary according to the economic multiplier used and the manner in which the fish were marketed.

In 1986 the net harvest is estimated to have a value of between 5.5 and 7.5 million dollars.

The harvests noted do not include the economic value of salmon that contributed to the troll fishery or the growing value of the local recreational harvest.

Since the initiation of the Salmonid Enhancement Program an estimated twenty million dollars have been spent on various projects to increase the harvest of salmon originating from streams on the Queen Charlotte Islands. This investment represents a major policy decision of our federal government to bring pacific salmon populations back to historic levels.

As Canadians we also have some new obligations as a result of commitments made in signing the Pacific Salmon Treaty. We recognize that our salmon resource spans our national boundaries and that preservation of rearing habitat is a common problem. The rehabilitation of declining chinook salmon stocks was a major reason for the decision to commit both countries to a rebuilding program that has specific objectives. Although chinook stocks are of minor concern to resource managers and harvestors on the Charlottes it is generally agreed that once these stocks being to recover, the emphasis will shift to the serious decline of coho salmon stocks. As many of you already know, the Queen Charlotte

Islands' streams are major producers of coho and it is probable that resource management decisions that affect this stock will be more thouroughly scrutinized.

The point that needs to be made is that the Department of Fisheries and Oceans are continually being presented with harvest and escapement objectives that are measureable. The Department is expected to fulfill its objectives within prescribed time periods.

When representatives of the forest industry meet face to face with those public resource managers who are expected to represent the public interest regarding fish values, it may be a serious mistake to dismiss their involvement as obstructive. The industry they represent is becoming increasingly vociferous about their concerns.

I also realize that people from the fishing industry need to expand their understanding about the realities facing logging firms; profit margins are decreasing as cost and international competition escalates. When listening to representatives of this industry it is readily apparent that people feel 'hammered' as a result of several events that have captured the attention of the public provincially, nationally and even internationally. Some of my friends and former students who work in the bush resent this treatment. I have some sympathy with their response. The faller who fells a tree is not to be singled out over I who use the paper and a multitude of benefits. It's a basic fact that here in B. C. we sustain ourselves with our resources. Blaming behavior is not constructive.

The real issue is how are we going to maximize our resources so as to benefit continually from them. Any approach to resolving resource management conflicts is enhanced if information can be shared and discussed. This workshop and the work of the Fish Forestry Interaction Program is part of the process which could result in better resource management.

How will we determine future success?

There is a subjective litmus test you may wish to consider. Let me develop this through an indirect approach.

One common experience of resource users and managers is the increasing difficulty to make decisions regarding harvests without the objection of an interest group. Decisions regarding allocation and harvesting is increasingly coming under the scrutiny of public interest groups.

If both public and private resource managers do not come to grips with the issues surrounding resource use and demonstrate that they are effective and responsible managers than the oppourtunity to provide resolution from this sector will continue to be diminished.

This is the litmus test: can we resolve potential conflicts as managers and havesters or will the conflicts increasingly become the focus of media events?

This meeting and your willingness to participate is a constructive, responsible response to these issues. You still have an opportunity to provide some leadership.

Societies survive like organisms, by their ability to meet changing situations with new alternatives. If new approaches are required then what are the attributes of leadership that will provide a direction that will earn the trust and confidence of the public?

Charles Ritchie, an eminent Canadian diplomat was a diarist who refected on this question during his long career. He identified some characteristic ingredients that I would like to share. They are: first, a willingness to confront unequivocally the major sources of a problem and not to dismiss arbitrarily what could prove significant; second, a definite sense of commitment to solve a particular problem; third, the ability to know when to change by knowing how to adapt to changing circumstances; and finally, the ability to gain acceptance for solutions based on knowledge, which is understood and shared.

I would like to remind you once more that it is to your benefit to develop mutual agreement. As for gaining public confidence and support for your decisions the future is not getting any longer. The onus is on you to proceed to resolve potential conflicts with the tools and information which have been developed.

APPENDIX 1. FFIP Queen Charlotte Islands workshop participants

PUBLIC

Patrick Armstrong
Moresby Island Concerned
Citizens Society
Sandspit, B.C.
VOT 1TO

John Broadhead
Island Protection Society
343 Sylvia
Victoria, B.C.
V8V IC5

Dave Bustard
Box 2792
Smithers, B.C.
VOJ 2NO

Duane Gould
Morseby Island
Advisory Planning Commission,
Sandspit, B.C.
VOT 1TO

Russ Jones
Council of Haida Nation
HAIDA GWAAII
Box 589
Masset, B.C.
VOT 1MO

Gerry Johnson
Grahan Island Advisory
Planning Commission,
Port Clements, B.C.
VOT 1RO

Bill Lefeaux Valentine
General Delivery
Queen Charlotte City, B.C.
VOT 1SO

Dr. Terry Lewis
6149 Burns Street
Burnaby, B.C.
V5H 1X3

Bruce McDonald
c/o O. Langer
80 - 6th Street
New Westminster, B.C.
V3L 5B3

INDUSTRY
NON-COFI

Esa Aatlma
Manager
Weldwood of Canada
Box 2179
Vancouver, B.C.
V6B 3V8

Dave Calder
Elk River Division
B.C. Forest Products
830-13th Avenue
Campbell River, B.C.
V9W 4H2

Paul Lawson
Husby Trucking Ltd.
Sandspit, B.C.
VOT 1TO

J. Leesing
Western Forest Products Ltd.
1200 - 1140 West Pender Street
Vancouver, b.C.
V6E 4G6

Steve Pestell
Weldwood of Canada
Box 2179
Vancouver, B.C.
V6B 3V8

R. J. Reid
Woodlands Manager
Tolko Industries Ltd.
P.O. Box 39
Vernon, B.C.
V1T 6M1

Jace Standish
Suite 600
1281 West Georgia Street
Vancouver, B.C.
V6E 3J7

Ms. Kate Sullivan
Weyerhaeuser Company
Western Forestry Research Center
505 North Pearl Street
Centralia, WA 98531

INDUSTRY
COFI

Michel de Bellefeuille
MacMillan Bloedel Ltd.
Queen Charlotte Division
Box 10
Justkatla, B.C.
VOT 1JO

Eric Bentsen
Logging Manager
Sandspit Operation
Crown Forest Industries Ltd.
Coast Wood Products
P.O. Box 2000
New Westminster, B.C.
V3L 5A4

Paul Berg
Road Construction Foreman
Crown Forest Industries Ltd.
Coast Wood Products
P.O. Box 2000
New Westminster, B.C.
V3L 5A4

David Bishop
MacMillan Bloedel Ltd.
Eve River Division
P.O. Box 160
Sayward, B.C.
VOP 1RO

Trevor Boniface
Resident Engineer
Queen Charlotte Operations
Western Forest Products
Sewell Inlet, B.C.
VOT 1TO

Herschel Boydston
Divisional Forester
Mainland Operation
Canadian Forest Products Ltd.
2800-1055 Dunsmuir Street
P.O. Box 49420
Bentall Postal Station
Vancouver, B.C.
V7X 1B5

G. Brennenstuhl, Engineer
Beaver Cove Operations
Crown Forest Industries Ltd.
Coast Wood Products
P.O. Box 2000
New Westminster, B.C.
V3L 5A4

Peter Bruce
Fisheries Biologist
LUPAT
Woodlands Services Division
65 Front Street
Nanaimo, B.C.
V9R 5H9

Brian Bustard
Assistant General Manager,
Logging, H.O.
B.C. Forest Products Ltd.
1050 West Pender Street
Vancouver, B.C.
V6E 2X3

Paul Chapman
Development Engineer
MacMillan Bloedel Ltd.
Queen Charlotte Division
Box 10
Justkatla, B.C.
VOT 1JO

Steve Chatwin
Soil Scientist
LUPAT
Woodlands Services Division
65 Front Street
Nanaimo, B.C.
V9R 5H9

Jim Connor, Manager
MacMillan Bloedel Ltd.
Queen Charlotte Division
Box 10
Justkatla, B.C.
VOT 1JO

Doug Cooper
Council of Forest Industries
1500-1005 West Hastings St.
Vancouver, B.C.
V6E 2H1

Susan Craven, Forester
Sandspit Operations
Crown Forest Industries Ltd.
Coast wood Products
P.O. Box 2000
New Westminster, B.C.
V3L 5A4

Dino Diaha
Area Engineer
Skeena Sawmills
P.O. Box 10
Terrace, B.C.
V8G 4A3

John Ducette
Area Engineer
MacMillan Bloedel Ltd.
Queeen Charlotte Division
Box 10
Justkatla, B.C.
VOT 1JO

John Duncan
Divisional Forester
MacMillan Bloedel Ltd.
Queen Charlotte Division
Box 10
Justkatla, B.C.
VOT 1JO

Wayne Green
Divisional Engineer
Englewood Operations
Canadian Forest Products Ltd.
2800-1055 Dunsmuir Street
P.O. Box 49420
Bentall Postal Station
Vancouver, B.C.
V7X 1B5

Hank Hansen
General Manager
Western Forest Products
1200-1140 West Pender St.
Vancouver, B.C.
V6E 4G6

Don Hoffman
Chief Forest Engineer
Crown Forest Industries Ltd.
Coast Wood Products
P.O. Box 2000
New Westminster, B.C.
V3L 5A4

Bob Howard
Forestry Manager, H.Q.
B.C. Forest Products Ltd.
1050 West Pender Street
Vancouver, B.C.
V6E 2X3

Harvey Hurd
Logging Manager
Queen Charlotte Operations
Western Forest Products
1200-1140 West Pender Street
Vancouver, B.C.
V6E 4G6

Bud Iverson, Logging Manager
Campbell River Division
B.C. Forest Products Ltd.
1050 West Pender Street
Vancouver, B.C.
V6E 2X3

Jim Jackson
Division Engineer
Sproat Lake Division
65 Front Street
Nanaimo, B.C.
V9R 5H9

Damian Keating
Divisional Forester
Skeena Sawmills
P.O. Box 10
Terrace, B.C.
V8G 4A3

Ted Kimoto
Division Manager
Northwest Bay Operation
65 Front Street
Nanaimo, B.C.
V9R 5H9

Dick Kosick
Regional Engineer
CIP INC.
P.O. BOX 459
Qualicum, B.C.
VOR 2TO

Kerry McGourlick
Western Forest Products
Sewell Inlet, B.C.
VOT 1TO

Doug Mosher
Operation Engineer,
Sandspit Operation
Crown Forest Industries Ltd.
Coast Wood Products
P.O. Box 2000
New Westminster, B.C.
V3L 5A4

Don Murray
Area Engineer
MacMillan Bloedel Ltd.
Queen Charlotte Division
Box 10
Justkatla, B.C.
VOT 1JO

Del Pratt
Road Construction Foreman
Holberg
Western Forest Products
1200-1140 West Pender Street
Vancouver, B.C.
V6E 4G6

Doug Rickson
Chief Forester
Canadian Forest Products
2800-1055 Dunsmuir Street
P.O. Box 49420 Bentall Postal Station
Vancouver, B.C.
V7X 1B5

Terry Rollerson
Senior Soil Scientist
LUPAT
Woodlands Services Division
65 Front Street
Nanaimo, B.C.
V9R 5H9

Joe Ronyecz
Senior Forest Engineer
Western Forest Products
1200-1140 West Pender Street
Vancouver, B.C.
V6E 4G6

B. Storry, Engineer
Mid Coast Operation
Crown Forest Industries Ltd.
Coast Wood Products
P.O. Box 2000
New Wesminster, B.C.
V3L 5A4

Hugh Sutdliffe
Superintendent, Forestry & Engineering
CIP Inc.
P.O. Box 220
Gold River, B.C.
VOP 1GO

C. Baldry White, Engineer
Sandspit Operations
Crown Forest Industries Ltd.
Coast Wood Products
P.O. Box 2000
New Westminster, B.C.
V3L 5A4

Ray Zimmerman
Divisional Engineer
MacMillan Bloedel Ltd.
Queen Charlotte Division
Box 10
Justkatla, B.C.
VOT 1JO

B.C. MINISTRY OF FORESTS AND LANDS

NELSON FOREST REGION

Dave Toews
B.C. Ministry of Forests and Lands
Nelson Region
518 Lake St.
Nelson, B.C.
V1L 4C6

PRINCE RUPERT FOREST REGION

Brian Downie
Forestry Manager
Ministry of Forest and Lands
Smithers, B.C.

John Perras
RO Timber
Kalum
Ministry of Forest and Lands

Charlie Willson
District Manager
Ministry of Forests and Lands
West Hwy 62
Box 215
Hazelton, B.C.
VOJ 1YO

VANCOUVER FOREST REGION

R. Jordens
Engineer
Ministry of Forests and Lands

D. Smith
Engineer
Ministry of Forests and Lands

QUEEN CHARLOTTE ISLANDS REGION

Ralph Backer
Small Business Coordinator
c/o Terry Dyer
Ministry of Forests and Lands
Queen Charlotte City, B.C.
VOT 1SO

Louis Boureet
R.A. Timber
c/o Terry Dyer
Ministry of Forests and Lands
Queen Charlotte City, B.C.
VOT 1SO

Doug Erickson
R.A. Timber
c/o Terry Dyer
Ministry of Forests and Lands
Queen Charlotte City, B.C.
VOT 1SO

Debbie Gardiner
Ministry of Forests and Lands
Queen Charlotte City, B.C.
VOT 1SO

Ben Hansen
Operations Superintendent
c/o Terry Dyer
Ministry of Forests and Lands
Queen Charlotte City, B.C.
VOT 1SO

Rob Pollock
Operations Superintendent
c/o Terry Dyer
Ministry of Forests and Lands
Queen Charlotte City, B.C.
VOT 1SO

Clift Valentin
R.A. Timber
c/o Terry Dyer
Ministry of Forests and Lands
Queen Charlotte City, B.C.
VOT 1SO

Steve Willis
R.O. Silviculture
c/o Terry Dyer
Ministry of Forests and Lands
Queen Charlotte City, B.C.
VOT 1SO

Don Youwe
R.A. Timber
c/o Terry Dyer
Ministry of Forests and Lands
Queen Charlotte City, B.C.
VOT 1SO

RESEARCH BRANCH

K. Illingworth
Director
Ministry of Forests and Lands
Victoria

B.C. MINISTRY OF ENVIRONMENT AND PARKS

Glen Carlson
Head, Habitat Section
Fish and Wildlife
Ministry of Environment and Parks
10334 - 152A St.
Surrey, B.C.
V3R 7P8

T. Chamberlin
Habitat Protection and Inventory Section
Fisheries Branch
Ministry of Environment and Parks
780 Blanshard Street
Victoria, B.C.
V8V 1X5

Dionys DeLeeuw
Fish and Wildlife Branch
Ministry of Environment and Parks
Box 370
Queen Charlotte City, B.C.
VOT 1SO

A. Edie, Head
Habitat Section
Fish and Wildlife
Ministry of Environment and Parks
3726 Alfred Street
Bag 5000
Smithers, B.C.
VOJ 2NO

Don Howes
Fisheries Branch
Ministry of Environment Parks
780 Blanshard St.
Victoria, B.C.
V8V IV4

D. Jones, Head
Habitat Section
Fish and Wildlife
Ministry of Environment and Parks
3547 Skaha Lake Rd.
Penticton, B.C.
V8A 2K23

Jorma Jyrkkanen
Fish and Wildlife
Ministry of Environment and Pakrs
4825 Keith Avenue
Terrace, B.C.
V8G IK7

D. King, Head
Habitat Section
Fish and Wildlife
Ministry of Environment and Pakrs
1011 - 4th Ave.
Prince George, B.C.
V2L 3H9

S. MacDonald, Head
Habitat Section
Fish and Wildlife
M<inistry of Environment and Parks
1259 Dalhousie Drive
Kamloops, B.C.
V2C 5Z5

D. Narver, Director
Fisheries Branch
Ministry of Environment and Parks
780 Blanshard Street
Victoria, B.C.
V8V 1X4

D. Morrison, Head
Habitat Section
Fish and Wildlife
Ministry of Environment and Parks
2569 Kenworth Road
Nanaimo, B.C.
V9T 4P7

Ms. Juanita Ptolemy
Recreational Fisheries Section
Fisheries Branch
Ministry of Environment and Parks
780 Blanshard Street
Victoria, B.C.
V8V 1X5

Brian Robertson
Fish and Wildlife
Ministry of Environment and Parks
2569 Kenworth Rd.
Nanaimo, B.C.
V9T 4P7

Colin Spence
Fish and Wildlife
Ministry of Environment and Parks
540 Borland Street
Williams Lake, B.C.
V2G IR8

B. Thompson, Geologist
Habitat Protection and Inventory Section
Fisheries Branch
Ministry of Environment and Parks
780 Blanshard Street
Victoria, B.C.
V8V IX5

Ray Travers, Forestry Specialist
Habitat Protection and Inventory Section
Fisheries Branch
Ministry of Environment and Parks
780 Blanshard Street
Victoria, B.IC.
V8V 1X5

CANADA DEPARTMENT OF FISHERIES AND OCEANS

B. Dane
Department of Fisheries & Oceans
#80 - 6th Street
New Westminster, B.C.
V3L 5V3

Chris Dragseth
Box 99
Queen Charlotte City, B.C.
VOT 1SO

L. Enderud
Box 99
Masset, B.C.
VOT 1TO

Victor Fredette
Department of Fisheries and Oceans
Masset, B.C.
VOT 1MO

D. Girodat
Box 280
Federal Building
Port Alberni, B.C.
V9Y 7M7

J. Greenlee
Box 130
Bella Coola, B.C.
VOT 1CO

Eero Karanka
114- 417 2nd Ave. W.
Prince Rupert, B.C.
V8J 1G8

D. Knapton
109 - 417 - 2nd Ave. W.
Prince Rupert, B.C.
V8J 1G8

G. Kosakoski
202 - 317 Seymour Street
Kamloops, B.C.
V2C 2E9

John Payne
1090 W. Pender Street
Vancouver, B.C.
V6E 2P1

Dennis Rowse
l090 West Pender Street
Vancouver, B.C.
V6E 2P1

G. Savard
Box 222
Sandspit, B.C.
VOT 1TO

C. Scrivener
Pacific Biological Station
Hammond Bay Road
Nanaimo, B.C.
V9R 5K6

F. Voysey
Department of Fisheries & Oceans
Box 6l0
Clearwater, B.C.
VOE 1NO

I. Williams
Salmon Research Lab
Cultus Lake, B.C.
VOX 1HO

FFIP STEERING COMMITTEE

Mr. Earl Anthony
Assistant Deputy Ministry
Ministry of Environment and Parks
Parliament Bldgs.
Victoria, B.C.
V8W 1X5

Dr. F. C. Boyd, Chief
Habitat Management Division
Dept. of Fisheries & Oceans
1090 West Pender Street
Vancouver, B.C.
V6E 2P1

Mr. John Cuthbert
Chief Forester
Ministry of Forests and Lands
1450 Government Street
Victoria, B.C.
V8W 3E7

Mr. George Edgson
General Manager, Woodlands
MacMillan Bloedel Ltd.
65 Front Street
Nanaimo, B.C.
V9R 5H9

Mr. G.V. Wellburn, R.P.F., P.Eng.
FERIC
Suite 201 - 2112 West Broadway
Vancouver, B.C.
V6K 2C8

Mr. Dave Winston
Program Director
Forest Renewal and
Environmental Research
Canadian Forestry Service
Pacific Forestry Centre
506 West Burnside Road
Victoria, B.C.
V8Z 1M5

FFIP TECHNICAL ADVISORY COMMITTEE

Mr. Ted Baker
Research Branch
Ministry of Forests and Lands
1450 Government Street
Victoria, B.C.
V8W 3E7

Mr. Mike Brownlee
Habitat Management Unit
Dept. of Fisheries & Oceans
1090 West Pender Street
Vancouver, B.C.
V6E 2P1

Mr. Allan Cowan
Dept. of Fisheries & Oceans
Box 99
Queen Charlotte City, B.C.
VOT 1SO

Mr. Terry Dyer
District Manager
Ministry of Forests and Lands
Box 39
Queen Charlotte City, B.C.
VOT 1SO

Mr. Robert Laird
Hydrologist
Vancouver Forest Region
Ministry of Forests and Lands
4595 Canada Way
Burnaby, B.C.
V5G 4L9

Mr. R. Morley
Fisheries Branch
Ministry of Environment and Parks
780 Blanchard Street
Victoria, B.C.
V8V 1X5

Mr. V.A. Poulin
Project Manager
2153 West 46th Avenue
Vancouver, B.C.
V6M 2L2

Mr. Leslie Powell
Habitat Management Unit
Dept. of Fisheries & Oceans
1090 W. Pender St.
Vancouver, B.C.
V6E 2P1

Mr. Tony Sauder
FERIC
#201 2112 West Broadway
Vancouver, B.C.
V6K 2C8

Mr. Jim Schwab
Research Section
Ministry of Forests and Lands
P.O. Bag 5000
Smithers, B.C.
VOJ 2NO

Ms. Sylvia Von Schuckmann
Ministry of Environment and Parks
Box 370
Queen Charlotte City, B.C.
VOT 1SO

Mr. Dave Wilford
Research Section
Ministry of Forests and Lands
P.O. Bag 5000
Smithers, B.C.
VOJ 2NO

FFIP SCIENTIFIC ADVISORY PANEL

Dr. W. Bourgeois
MacMillan Bloedel Ltd.
Land Use Planning Advisory Team
65 Front Street
Nanaimo, B.C.
V9R 5H9

Dr. Jeff Cederholm
Dept. of Natural Resources
R.R.1,
Box 1375
Forks, Washington
98331

Dr. M. Church
Department of Geography
Room 217, 1982 West Mall
University of B.C.
Vancouver, B.C.
V6T 1W5

Dr. Philip Cottell, Director
Wood Harvesting Research
MacMillan Bloedel Ltd.
3350 East Broadway
Vancouver, B.C.
V5M 4E6

Dr. Doug Swanston
U.S. Dept. of Agriculture
Pacific Northwest Forest and
Range Experiment Station
Forestry Science Laboratory
P.O. Box 909
Juneau, Alaska 99802

FFIP PROJECT LEADERS

Mr. William Carr
Apt. 506
5932 Patterson Ave.
Burnaby, B.C.
V5H 4B4

Mr. Dan Hogan
4346 West 15th
Vancouver, B.C.
V6R 3A8

Mr. Herb Klassen
266 - 48th Street
Delta, B.C.
V4M 2N1

Mr. Ray Krag
FERIC
#201 - 2112 West Broadway
Vancouver, B.C.
V6K 2C8

Mr. V.A. Poulin
Project Manager
2153 West 46th Avenue
Vancouver, B.C.
V6M 2L2

Mr. Kenneth Rood
3484 Oxford Street
Vancouver, B.C.
V5K 1N9

Mr. Peter Sanders
University of British Columbia
Research Forest
R.R. 2
Maple Ridge, B.C.
V2X 7E7

Mr. Tony Sauder
FERIC
#201 2112 West Broadway
Vancouver, B.C.
V6K 2C8

Dr. Dick Smith
Pacific Forestry Centre
506 West Burnside Road
Victoria, B.C.
V8Z 1M5

Mr. Derek Tripp
Site T1, RR1
Nanaimo, B.C.
V9R 5K1

APPENDIX 2. Fish / Forestry Interaction Program Queen Charlotte Islands workshop questionaire.

Compiled by: Leslie Powell
Department of Fisheries and Oceans

131 questionnaires were sent out following the Workshop.

56 responses were received by January 30th, 1987 and tallied to provide this summary.

1. *Did you find the QCI Workshop useful?*

   All agreed that they found the Workshop useful, with 4 indicating it was of limited usefulness.

2. *Will it be effective in modifying working procedures in a practical way?*

Definitely	16
Probably	26
Doubtfully	6
Definitely Not	3

3. *What specific elements were particulary useful?*

	very useful	useful	limited usefulness	not useful	no opinion
a) presentation	6	37	3	3	7
b) working groups	10	33	3	3	6
c) field trips	2	26	11	4	13
d) all participant discussions	6	26	9	3	14
e) w.g. summaries	4	26	9	4	13

f) other15 answers in 56 replies commented on:

-value of informal sessions
-good exchange of ideas
-good mix of people (agency/industry)

4. *Was the Workshop too long? Not long enough?*

   54 out of 56 people felt the length of the Workshop was right, while 1 person felt it was too long and 1 person felt it was too short.

5. *Was the location to the Workshop appropriate?*

   52 people felt the location was correct, 2 said it could have been held anywhere and 2 said the location was expensive.

6. *Any further specific recommendations for implementation of results?*

39 replies discussed recommendations for implementing results. These included a range of suggestions from "getting on with the job at once" to "Don't develop any new guidelines". Most suggestions were of a general nature, and some related to future research topics.

Specific recommendations suggested included:

-have follow-up meetings as implementation proceeds;
-develop handbooks for field staff;
-involve industry and agency people in process;
-more small scale workshops needed;
-keep specific to Charlottes, do not apply coastwide;
-compile a standard operating procedures manual.

7. *Any further specific recommendations for follow-up research?*

41 replies offered suggestions for further research. The topics included:

-prediction of slides'
-silvicultural alternatives;
-role fo large organic debris;
-duration of impacts;
-examine role for debris in gullies;
-more work on slope rehabilitation;
-effects of gravel compaction on pink and chum spawning;
-cost/benefit studies;
-more work on stream rehabilitation;
-downstream impacts (over time) from slide events.

8. *Any other comments/suggestions?*

41 replies also gave additional comments for suggestions. Seventeen of these were positive feedback on the Workshop. A few indicated that the field trips had been too short. One reply suggested an annual fish/forestry workshop. Another quartrer of the replies commented on the need for improving industry/agency cooperation and interaction in dealing with fish/forestry problems. Six replies identified the need to study economic and social aspects of the fish/forestry problems. Other suggestions included:

-the need for more fish inventory data;
-the need to involve engineering in stream rehabilitation work;
-the need to study the magnitude of the effects;
-the need for rehabilitation in logged areas;
-the need for wide dessemination of the results using, for example, information bulletins;
-the need to keep the initiative going;
-the use of graduate students for stream rehabilitation rather than in-house expertise from agencies was questioned.